TANGANYIKA TERRITORY

DEPARTMENT OF AGRICULTURE

Annual Report

1931

IMPERIAL MYCOLOGICAL
21 DEC. 1932
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DEPARTMENT OF AGRICULTURE.

ANNUAL REPORT, 1931.

Staff.

The Director was in control of the Department throughout the year. The vacant post of Deputy Director was not filled for reasons of economy. Mr. J. F. C. O'Brien, Senior Agricultural Officer, acted as Deputy Director until 30th March, 1931, when he was obliged to go on sick leave and was later invalided out of the service. During the year the following changes were recorded :—

Messrs. R. Shaw and T. K. Ferreira, Agricultural Assistants, left the service.

At the close of the year the authorized staff was :—

Head Office: Director ; Deputy Director ; three European clerks.

Scientific Staff: Entomologist ; Mycologist ; Assistant Entomologist.

Field Staff: Four Senior Agricultural Officers ; Agricultural Lecturer ; twenty-eight District Agricultural Officers ; Head Gardener and fifteen Agricultural Assistants.

One post for a Senior Agricultural Officer, one post for a District Agricultural Officer and three posts of Agricultural Assistants were vacant at the end of the year.

In Appendix I is shown the distribution of the staff by districts.

Finance.

As this report is for the period ending 31st December, 1931, and the financial year runs from April 1931 to March 1932, it is not possible to give complete figures for expenditure.

The following table shows the provision made in the estimates for the year and the amounts expended for the nine months ending 31st December, 1931 :—

Details of Expenditure	Provision for year	Actual Expenditure to 31/12/31
	£	£
XXV.—AGRICULTURE.		
Personal Emoluments.		
1. Director	1,350	1,013
2. Deputy Director	250	—
3. Agricultural Economist	764	569
4. Entomologist	907	677
5. Assistant Entomologist	551	411
6. Mycologist	750	563

Details of Expenditure	Provision for year	Actual Expenditure to/31/11/31
	£	£
XXV.—AGRICULTURE.—(*contd.*).		
PERSONAL EMOLUMENTS.—(*contd.*).		
7. Plant Breeder...	—	—
8. Agricultural Lecturer	660	495
9. 3 Senior Agricultural Officers	3,152	2,240
10. 34 District Agricultural Officers	15,080	10,860
11. 2 Cotton Investigators	—	—
12. Head Gardener, Dar es Salaam	534	401
13. 15 Agricultural Assistants	5,222	3,578
14. Chief Clerk	600	450
15. 2 European Clerks	781	583
16. Acting Allowances	40	—
17. Clerks:—		
1 1st grade	945	632
1 2nd ,, ...		
3 3rd ,, ...		
1 4th ,, ...		
18. African Clerks:—		
Higher Division	461	257
1 Grade III		
Lower Division		
3 Grade I		
6 ,, II		
19. African Instructors:—		
20 Senior Native Instructors	6,367	3,283
226 Native Instructors		
20. 5 Overseers, Agriculturul Stations	1,243	684
21. 10 Station Foremen	342	188
22. Motor Driver	51	37
23. Messengers	150	115
24. House Allowances	30	34
Total Personal Emoluments £ ...	40,230	27,070
OTHER CHARGES.		
25. Purchase of Seeds	350	165
26. Distribution of Cotton Seed	—	—
27. Upkeep of Agricultural Stations	3,000	1,548
28. ,, ,, Government Plantations	50	—
29. ,, ,, ,, Gardens, etc.	600	407
30. ,, ,, Ploughing Schools	150	33
31. Plant Sanitation	200	68
32. Tools and Implements	250	208
33. Laboratory Equipment	100	88
34. Books of Reference	100	16
35. Water	35	22
36. Travelling Allowances	1,760	576
37. Transport ,, ...	3,420	1,332

Details of Expenditure	Provision for year	Actual Expenditure to 31/12/31
	£	£
XXV.—AGRICULTURE.—[*contd.*].		
OTHER CHARGES.—(*contd.*).		
38. Transport	2,500	850
39. Railway Fares and Freights...	1,500	1,160
40. Passages	1,130	563
41. Tents and Camp Equipment	325	238
42. Uniforms for Agricultural Instructors	75	77
43. Typewriters	50	47
44. Upkeep of Museum	20	4
45. Agricultural Shows	20	—
46. Scholarship Scheme Contribution	1,330	1,330
47. Imperial Agricultural Bureaux	200	200
48. ,, Bureau of Entomology Contribution ...	500	500
49. ,, ,, ,, Mycology Contribution ...	100	250
50. East African Agricultural Research Station Contribution	6,000	6,000
51. Colonial Agricultural Service Contribution to Central Fund	540	540
52. Colonial Agricultural Research Service Contribution to Service and Research Station	—	—
53. Anti-locust Research Scheme, Contribution to ...	—	—
54. Upkeep and Maintenance of Motor Vehicles ...	120	55
55. Telegrams and Telephones	850	174
56. Outfit Allowances	120	—
57. Stationery	300	132
58. Messengers' Bicycles	48	25
59. Contingencies	150	44
60. Purchase of Cotton Seed	6,600	512
61. Bagging of ,, ,, ...	500	10
62. Scales for Cotton Markets	100	60
63. Transport of Cotton Seed	2,000	569
64. Supervision of Cotton Markets	630	380
65. Contingencies, Cotton Seed Distribution	30	—
Total Other Charges ... £	35,753	18,183
SPECIAL EXPENDITURE.		
67. Office Safe	50	42
Anti-locust Measures	4,000	2,106

GENERAL REVIEW OF THE YEAR.

(By the Director).

The 1931 season was a disappointing one as, coupled with a continuation of the fall in prices for export crops of all descriptions, there was a poor season in the Tabora and Mwanza Provinces together with a locust infestation. To this must be added a pronounced reluctance on the part of native people to plant crops for sale, they concentrated on food crops to such an extent that they may be said to have slipped back to subsistence farming purely. As the opportunities for employment for wages became fewer, and as the production of cash or revenue crops shrunk considerably the native people became impoverished financially and were courting danger.

Where natives have a permanent crop, such as copra or coffee, with a fall in prices there comes a lethargy which is neither good for man nor crop so that damage which may become permanent is the result.

It may be said that the above is only a natural consequence, and the native producer adopts a correct attitude when he acts in this way. He may be able to afford to do so personally but the structure which serves him will suffer unless he does something to support it. This fact has come closely home to many as they find their own institutions are involved in the common poverty, and it is some tribute to their wisdom, that many native groups were taking timely action towards the end of the season in an endeavour to repair the damage.

The policy of permitting native people to prosecute their activities without active guidance and exhortation is perhaps sound only when times are good, when people are hard put to it it is important that they be given a lead and constantly exhorted to endeavour to repair their poverty by additional and extensive activity. This has been done and the outcome is awaited with some interest and not a little anxiety on account of the locust invasion which at the end of the year promised to become more intensive.

Although agricultural officers in the various districts were instructed in good time to press for increased production from native areas for the season 1931, their unaided efforts were unavailing to influence native inclinations, and all that was demonstrated was the ineffectiveness of agricultural officers acting alone to influence the volume of production in a district by the application of increased energy. Prior to the planting season in the last quarter of 1931 a concerted effort on the part of Native Authorities and their advisers was set in motion and the outcome of that effort is anxiously awaited by trading, transport and shipping interests.

Whilst poor times and bad prices had their very depressing effect on native effort, the effect on non-native production was not so marked—and slowing up was mainly due to inability to secure the financial aid essential to full production. Thus we have the demonstration that sustained effort is natural to the producer requiring capital support whilst heavily fluctuating effort is characteristic of the "no cost" producer.

The value of non-native effort in sustaining tonnage of output in bad times must be assessed at its true value, and a just balance between the two

forms of production should be struck. Furthermore the productive capacity of a native working within an organization and under constant direction is many times greater than where the same man works alone. Some observers put the difference at five times, one is inclined to consider this hopelessly low. In any case it is clear that the productive capacity of our native people and the volume of production from the Territory could be largely increased were non-native enterprise to take more interest in the country.

In the Lindi Province, which is fertile and used to be a good producing area, non-native production from a few estates employing about 6,000 labourers accounted for fifty per cent. of the value of exports during 1931, the balance of the population, some 350,000 souls, supplied the other half. Similarly in the Northern and Tanga Provinces we have a dominance of estate production in the export totals. It is thus deduced that practical support to non-native enterprise in a native territory such as Tanganyika is well worth while and that to achieve steadiness of outturn and of trade, each should be equally supported as they are in effect complementary and not opposed. The combination of non-native technical direction in connection with native production is destined to prove of far reaching consequence in the Territory, thus, ginneries, pulperies, tobacco curing works, coffee curing works, wax clarifying centres, oil mills, ghee centres, meat works and possibly copra preparing plants, are essentials to the fullest development of native agricultural effort and demand non-native co-operation. Finally the exploitation of parts of this Territory directly by non-native workers is imperative if the assets and potentialities of the country are to be brought into the service of the world generally.

Development.—There have been few developments of particular note during the year. The Manyoni-Singida branch railway should be working in time for the 1932 crop, the extension of the Nyasaland Railways to the shores of Lake Nyasa should give impetus to development in the Songea-Rungwe areas of this Territory. Road communications are gradually improving.

It would prove of interest if some practical trials of crude oil motor trucks were undertaken, especially light 30-hundredweight and 2-ton trucks. Our roads, bridges and culverts are not yet good enough for trucks of a heavier type. Unless the trucks are relatively cheap in first cost, there is not much chance of competing successfully with the light petrol driven truck.

Bicycles as a means of transporting native grown crops to market might be more generally used. There are very few bicycles in use by natives. One often sees them laden with humanity carrying at least 500 pounds weight. Were strong bicycles constructed, provided with carriers fore and aft, a native could readily transport 100 pounds weight of produce on a bicycle. It would be the cheapest form of transport and might solve a few of our transport problems, as distances of up to 60 miles per day could be covered with a load in the dry season.

From now on the production of tea should increase considerably, it is of interest to note how soon after planting a large production of leaf is secured in the Usumbaras. Arrangements for the erection of a tea factory to serve a number of estates in Mufindi were completed during the year, and the acreage under tea in that district is steadily increasing.

No new ginneries were built during the year, there is excess ginning capacity already constructed in the Territory,

Enquiries were made by interested parties regarding the establishment of a coffee curing works at Moshi, and also at Bukoba. No doubt in due course modern factories will be erected to deal with the output of coffee from these areas.

A new tobacco factory was established in Dar es Salaam for the purpose of marketing tobacco in packets for native consumption. There is as yet too small a production of tobacco locally suitable for this purpose. The production of experimental consignments of Turkish tobacco in the Iringa area was continued, as prospects are good. There is a very large area of country suitable for this crop, the difficulty lies in the market which is not unlimited in its demands.

There is a scope for the establishment of black wattle plantations in the Usumbaras, by both native and non-native owners. The tree grows well and is a very useful crop. Even in the Ulugurus there is a field for the development of wattle growing, the use of this planting would help counteract the all too evident soil wash and deterioration which takes place as native hoes bite into the hills.

The citrus grower might find scope for enterprise, as it is possible to produce and ship citrus fruit at a time when the British and Continental market is somewhat bare of supplies, viz. September to October.

Furthermore should grape fruit gain in popularity, this fruit is most cheaply and excellently grown in the Territory.

The department is multiplying citrus trees for distribution by budding known strains of citrus on reliable local stocks. Similarly with mangoes.

A few people are producing and experimenting with the production of spices and of condiments, others are trying the distillation of various essential oils. Spices and essential oil plants are introduced by the department, propagated and distributed. It is rather a melancholy thing to record but there is a comparative absence of enquiry as to the openings and agricultural opportunities presented by the Territory.

There is no agricultural census taken annually which would at least indicate whether enterprise was at a standstill or not and which would enable people to speak with definiteness of the agricultural effort and output.

In all areas officers have made it a point to stress the need for the conservation of soil and of fertility. It is considered that it is possible to trace many of the difficulties facing plantation owners to the fact that generally speaking no extensive practical steps have been taken to hold the soil about the roots of trees, to reinforce the humus content, to equalize soil temperatures and generally to care for the basis of plant health. With native people also the careless exposure of smooth cultivation to the rush of water from sloping land above is to be well noted. Not even the minimum of wash protection is practised. With the *mtuta* system, i.e. alternate bank and furrow these may be found running at all angles on hill sides, a simple adjustment to the contour or near it would save much loss. The department is preaching the value of contour weed lines, and the danger of burning such weed lines. Used on the contour, weed cleanings hold up much soil and can be made the forerunners of a terraced lay out.

It is gratifying to record a strong reaction in favour of soil conservation by both planter and native. Particularly in Mufindi in the tea plantations

the contour line of weeds is to be remarked. In coffee plantations also in the Northern Province and amongst native people in the Mwanza Province there is much improvement. Many demonstration shambas have been laid out revealing the methods which may be used.

Cover cropping not only for soil shade and manuring but as a check to weed growth is now being studied by sisal growers. These simple practical aspects of methods of cultivation are being given more careful and general attention.

Further advance would be recorded would people plant crops earlier. Late planting, due to many causes, is a constant depressant of average yields. On the other hand there are many excellent native practices which indicate that the agricultural lore of many tribes is quite sound.

Marketing.

During the harvest of 1931 it became clear that in many districts, traders were so ill provided with ready money that barter was resorted to exclusively; where a native demanded cash for his produce he could sometimes secure it but often at a substantial premium; in some cases amounting to quite 100 per cent. The situation was carefully examined and the position considered.

As the barter system operates to distribute only the cheapest of imported goods, and as it does not offer a chance to a native of saving his money until such time as he can buy and pay for the things he would choose to buy, and further because it makes the payment of taxes either impossible or far more onerous than it should be on account of the premium on cash, it was considered that for at any rate some part of his harvest a native producer should be able to secure a proper cash payment.

The reasons for the state of affairs mentioned above are well understood and although one sympathizes with traders who are obliged to rectify their own position in the above way, still the effect on production of wholesale barter amongst individuals has to be considered and steps have been taken to see that at any rate there will be some supply of cash in the districts, thus providing a "liquid link" between the producer and the buyer.

There is another aspect of development as affected by marketing and that is where a trader or a technical operator develops some production by the investment of cash and time on the project in a district and, just as soon as ever he can, the free lance buyer steps in knowing that the entrepreneur, who often has sunk considerable capital in equipment, has to have a volume of produce to cover overheads or to meet contracts. The free lance buyer is merely concerned in making a profit, not particularly to invest in further development, but for his living and thus may become a burden on the project and on the district. This kind of thing has led to too many cotton buyers, too many ginneries, far too many coffee buyers, and in the end the producer pays. Further an investing trader and operator will not readily risk his money when he knows all too well that as soon as some volume of production has been created some other person or persons will step in and divide the harvest, without their having had to bear the burden of the early lean years.

It is also to be noted that when prices for produce are rising, competition is strong and numbers of people appear as buyers, pushing prices up to inordinate levels, when prices fall a number of buyers vanish; and thus, when competition would have a value in checking an undue fall in price to the

producer, it is inoperative. Thus the so-called value of competition is not as great as it seems, it creates heavy fluctuations in demand and in prices which are applied in the reverse order of effectiveness. Furthermore with rising prices a number of buyers arise who have no real knowledge of the crop and, in a season, by their ignorant and indiscriminate purchasing, are able to undo the work of several seasons which has been directed to improvement in quality. This is now happening on Kilimanjaro and has been observed in cotton buying in the Eastern Province and with coffee in Bukoba.

In September the poor condition in which Bukoba coffee deliveries were arriving in Mombasa led to a demand by brokers and merchants, for the application of Coffee Inspection Rules at the Port of Bukoba. Rules had been gazetted in June, 1930, but on the urgent and forceful representations of Mombasa merchants, Bukoba traders and principals in London, the application of the rules was suspended. In due course, with a fall in the markets, claims on Bukoba deliveries became more frequent and it was decided to apply amended rules. At the close of the year the composition of the rules was under discussion and it was proposed to apply them to the new crop commencing 1st April, 1932.

On Kilimanjaro, the number of coffee buyers increased considerably towards the end of the year, and on a rising market for Arabica coffee indiscriminate buying and bulking of little parcels of native coffee resulted. A system of stricter control of the activities of buyers is essential to rectify the position.

During the year a Marketing Organization Committee was set up which had the advice and assistance of Mr. C. F. Strickland, C.I.E. Meetings were held in the Northern and Tanga Provinces and a report was submitted in which it was recommended that co-operative society legislation should be adopted. Many matters relative to marketing were discussed but the position was clear that until growers could produce quantities of uniform material over known and suitable periods, they would continue to find it difficult to market their produce profitably.

Local Production for Local Consumption.

In January, 1931, the attention of producers in the Northern Province was drawn to the fact that considerable quantities of produce which could be grown in the Territory were being imported from overseas. The object was not to disturb the present exchange of commodities amongst the three East African Dependencies, as it is recognized that supplies should be drawn from those areas best equipped and situated to produce and deliver them, but rather to arouse an interest in the development of a diversified agriculture.

The ability to supply a market and keep it demands the added ability to organize the deliveries in sound condition, of suitable qualities at competitive rates and to meet the demands at the right season and for this generally speaking some organization is needed. The Marketing Organization Committee considered this carefully with the outcome mentioned above.

A table is given showing the importations for the year 1931, which total just over £100,000 and attention is drawn to the following items: Ghee, maize, flour, rice, spices, onions, potatoes, also tobacco, canned fruits, jams and sugar.

It may be impossible on account of seasons and trading systems to undertake the production and distribution of some of these items in the Territory

but the East African Group should endeavour to reduce amounts under a large number of these items in the import list.

VALUE AND QUANTITY OF CERTAIN FOODSTUFFS IMPORTED INTO THE TERRITORY DURING THE YEAR 1931.

PRODUCT.	DAR ES SALAAM		TANGA		MOSHI		MWANZA	
	Quantity	Value	Quantity	Value	Quantity	Value	Quantity	Value
	Cwts.	Shs.	Cwts.	Shs.	Cwts.	Shs.	Cwts.	Shs.
Wheat grain	5,545	65,704	531	6,346	74	793	33	383
Wheat flour	26,291	323,578	15,570	187,755	4,968	78,303	2,105	33,638
Maize	33,052	147,214	5,279	19,255	461	2,448	514	1,765
Maize meal and flour ...	6,910	53,711	1,300	9,850	694	3,106	6,882	34,840
Rice	5,945	89,333	12,954	152,837	3,035	38,255	100	1,563
Ham and bacon	274	31,013	76	11,196	108	15,196	30	4,709
Butter	849	125,807	166	28,483	103	19,066	87	15,788
Cheese	232	30,978	84	11,365	54	6,033	20	1,939
Coffee	34	2,987	24	1,865	1	123	29	1,743
Fresh fruit	—	20,657	—	1,104	—	2,812	—	291
Ghee	751	104,582	292	30,474	301	22,110	27	3,085
Garlic and onions	7,722	73,995	2,477	24,289	116	1,090	418	3,357
Potatoes	5,916	33,636	282	1,242	399	2,288	2,397	7,219
Spices	2,382	84,773	701	28,118	216	8,392	198	4,356
		1,187,968		514,179		200,015		114,676

Pests and Diseases.

A locust infestation, of the species known as migratorioides, was reported in February from Mwanza and an organization to cope with the menace was improvised. In most areas a good clearance was effected. Staff and transport was loaned by other departments and Native Authorities in most areas combined most effectively. Only in Musoma which is a comparatively undeveloped district was any serious damage done to crops as escapes were disproportionately high.

Baiting was unsuccessful, whilst beating, trenching and spraying were effective in achieving a heavy reduction of hopper bands. The action taken was timely, operations commencing at the end of February. All early and middle hatchings were destroyed and it was not until main harvesting was well started did flying swarms arise, thus crop damage was largely averted.

Operations were conducted in the Bukoba and Mwanza Provinces and in Shinyanga in Tabora Province. Great credit is due to the Senior Agricultural Officer, Mwanza, and to all those who collaborated with him in his work during the campaign.

A further invasion on a much heavier scale occurred in November, coming at the planting season. This first involved the Mwanza Province; then the pest spread rapidly and appeared in the Northern, Tanga, Central, Tabora, Bukoba, Kigoma Provinces and to the south. At the end of the year operations were being conducted with much energy, but the time of arrival of the infestation of fliers and its great extent made this second invasion much more serious and dangerous than the first above mentioned.

There was a local plague of grasshoppers in Dabaga. The bean beetle was very active and damaged the bean and pea crops in Morogoro. It is satisfactory to note that the Northern-Tanga Province still keeps its clean bill of health as regards stephanoderes and mealy bug, but thrips, borer and antestia are serious pests.

Rats.—Reports of considerable damage by rats and field mice came in June from Kimamba in the Kilosa District. There were reports also from the Rufiji. This pest had done damage in the Tabora and Kigoma Provinces the previous year, and it seems to appear regularly in waves in the Lindi Province.

Wholesale measures of control are not available. The chief danger is the migratory field mouse of the control of which but little is known. It would appear that as grass seeds ripen, and as maize and matama is harvested the pests grow in strength and move over the country until in June and July the main food left for the hordes is that found in ripening cotton bolls. This is irretrievably damaged by them and completes the tale of destruction. As the fields become dry and the amount of available food is reduced the pest dies away until it almost reaches vanishing point.

It is clear that any control will be more effective if applied to the survivors during the period of low intensity in order to check breeding up. The life history and occurrence of the pest is being investigated, it is hoped to discover in what areas the migratory forms pass the period September to March.

Scientific Work.

The scientific staff still remains small, namely two Entomologists and one Mycologist, the reports of these officers are included herein.

The Entomologist has been stationed for the whole year in the Northern Province where coffee plantations and entomological problems with coffee have occupied almost his entire time. His main work has been devoted to practical field trial to control antestia and thrips, coupled with demonstrations to planters. Block spraying has been inaugurated and plantation owners are gradually equipping their estates with up-to-date spraying outfits as a direct result of his demonstrations.

The Assistant Entomologist has been stationed at Morogoro the whole year, his work has concerned cotton and food crops generally, together with beeswax production and rodent pests. He also spent a considerable time in the field studying the hopper stages of *Locusta Migratoriodes*. He also investigated the pest position in Bukoba, and in the Southern Highlands in connection with both tea and coffee pests.

The Mycologist stationed at Morogoro was chiefly employed on investigating the fungoid diseases of grain crops, tea and coffee, and also abnormal manifestations in sisal. His laboratory accommodation has been considerably improved.

Experiment Stations.

Reports from these stations are attached.

Eastern Province.—The Morogoro station is devoted to trials of cotton planting and cotton varieties, varieties of native foodstuffs, particularly millets and root crops, demonstrations of contour soil wash control, sisal variety trial, besides which much propagation of planting material is undertaken. It is quite a suitable small station but results are vitiated at times by flooding and by predial larceny. As the station is within the township, the protection of crops is rendered somewhat difficult.

Tabora-Mwanza : *Lubaga-Ibadakuli.*—This station is at Shinyanga and is attached to a large seed raising farm under the Native Authority. It is intended to transfer practically all experimental work to Lubaga which is well sited and always accessible. Ibadakuli is frequently cut off during the rains. In order to round off the work of the Lubaga station, a lake shore experimental area should be established not too far from Mwanza. The main work done at Lubaga is on cotton together with fooderop and groundnut selections. When a lake shore station is provided, rice and cotton would be the chief crops to undergo selection and multiplication.

Rufiji : *Mpanganya.*—For all practical purposes, with the exception of rice selection, experimental work has ceased. Enough experimental data has been accumulated for the furtherance of native enterprise in this area, in which agricultural effort both by native and non-native is at a low ebb.

Mikindani : *Mpapura.*—This serves as a residential station for the District Agricultural Officer of Mikindani and is devoted to trials with food-crops on two typical soils of the district represented on the station. In addition, preliminary work is being undertaken with cotton, groundnuts and simsim.

Attention is drawn to the reports from the various stations—Morogoro, Ibadakuli, Mpanganya and Mikindani. In addition to the work of these stations a number of sub- or seed-stations are operated in various districts.

These have been established with the assistance of Native Authorities. The main lines of work carried out on them are times of planting and yield tests of introduced and local varieties of food and other crops together with the multiplication of desirable strains for issue locally.

In addition to the sisal, coffee and tobacco stations elsewhere referred to, and for which funds are not yet available, one experimental station only should be necessary in the near future, namely in the Kilombero, where with improvement in communications there should be some development.

Visitors.

His Excellency the Governor, Sir Stewart Symes, visited the station on 23rd June, 1931.

The Agricultural Adviser to the Secretary of State, Mr. F. A. Stockdale, and Mr. Seel paid a visit to the Territory early in the year, and at the end of their visit early in February a Technical Conference of Directors of Agriculture was held at Amani, and a report was issued regarding the deliberations. The visit was of great value to the department and discussions on the spot with local staff were of great interest.

Mr. Milligan of the Empire Cotton Growing Corporation visited the cotton areas of the Eastern Province and Mwanza with a view to advising the Government in regard to the steps to be taken to effect improvement in the uniformity and quality of the cotton crop of the Territory.

The visit of a tea expert was deferred until 1932.

The Director of Amani visited Morogoro in June, 1931, and gave helpful advice in regard to many matters.

The Head Office, Morogoro, was visited by twenty-one unofficial visitors during the year.

Publications.

The following pamphlets and leaflets were issued by the department during 1931; in addition a number of short articles were contributed to *Mambo Leo*:—

Serial Number	Title	Author
Pamphlets:		
No. 4	Coffee in South India	F. R. Sanders, District Agricultural Officer
No. 5	Tea in Ceylon and South India	,, ,,
Leaflets:	*Entomological:*	
No. 8	Cutworms	A. H. Ritchie, Entomologist
No. 9	Cold Oil Emulsion (Yother's *Florida* Formula)	,, ,,
No. 10	Beeswax	W. V. Harris, Assistant Entomologist
No. 12	Rats and Mice	,, ,,
Leaflets:	*Mycological:*	
No. 10	Bordeaux Mixture and some other Fungicides	Dr. G. B. Wallace, Mycologist
No. 11	The Smuts of Sorghums and their control	,, ,,

The Circle organization mentioned and described in the report for 1930 was established and consolidated during the year and has proven successful in that the details of departmental activities are controlled locally, and only matters of policy, and more important matters for decision are referred to head office. Such an organization grouping a varying number of provinces facilitates staffing and brings the affairs of the group of provinces into nearer focus. It does demand, however, a considerable amount of travelling on the part of the head of the department in that it is found convenient and useful to settle matters on the spot. Where one has a large territory and not too highly developed postal and railway facilities, it is essential to decentralize and pass out to the Circles some of the administrative and financial work which would otherwise be dealt with in head office with consequent delay.

The Government air service has been used extensively and is a great help in overtaking the work. Attention is drawn to the reports of officers in charge of Circles attached hereto.

It is a pleasant duty to pay tribute to the loyalty of the staff and to testify to their enthusiasm in the trying and depressing circumstances of the Territory during the year. Particularly also thanks are due to the officers of the Administration, Veterinary, Forestry and Tsetse Research departments for the spirit which has animated them in their efforts to co-operate for the betterment of existing conditions. It is also gratifying to record the strong spirit of co-operation which subsists between the Department and the Research Station at Amani. Generally a team spirit has been manifested. The interest of most officers has now been aroused to the necessity for giving further earnest consideration to the position of all primary producers in the Territory, and it is hoped that with even a slight change in the world conditions, their efforts will be rewarded.

NOTES ON THE CHIEF EXPORT CROPS.

Cotton.

It is regrettable to have to record that the decline in production in this crop has been progressive since 1929 and the 1931 figures show a large decrease on those of 1930. In the Tabora and Lindi areas, the crop has definitely declined in favour of the native grower; in Biharamulo it is unsuccessful. In the Eastern and Mwanza Provinces, the crop is still extensively cultivated, but in the former area owing to depredations by field mice and the low prices offering, much of the seed cotton was not harvested. In these areas, production is now being strongly encouraged and it is hoped that the 1932 production will show a definite increase. Seed multiplication of the U/4/4/2 variety is being pressed on and it is anticipated that when this hardy and heavy yielding variety can be generally introduced that cotton production will again be popularized in the Tabora Province, where conditions are usually adverse.

As this report is being compiled prior to the completion of the season's ginning, it is not possible to give the completed figures for lint production,

but in the following table approximate figures for 1931 are given based on the seed cotton production figures for the year, which are also given :—

Province	Lint in pounds				Seed-cotton in Pounds
	1928	1929	1930	1931 approx.	1931
Eastern	7,506,758	6,982,400	5,291,182	1,529,916	5,048,729
Tabora ...	478,701	98,000	111,800	51,858	172,861
Mwanza ...	4,422,357	3,012,800	3,325,489	2,604,597	8,681,991
Lindi ...	525,726	784,800	371,541	34,041	113,471
Tanga ...	106,721	127,199	68,500	56,292	187,640
Northern ...	105,134	70,800	52,650	10,146	33,827
Bukoba ...	36,127	38,090	33,104	873	2,196
Total ...	13,181,524	11,114,089	9,254,266	4,287,723	14,241,435
Bales ...	32,954	27,785	23,135	10,719	

Non-native production for 1931 is estimated at 1,835 bales (of 400 lb. each) or 16 per cent. of the whole as compared to 34 per cent. in 1930 and divided by districts as follows :—

Dar es Salaam District ...	29 bales	Rufiji District	Nil
Morogoro District ...	965 „	Lindi District	45 bales
Kilosa District	571 „	Northern Province ...	84 „
Bagamoyo District ...	23 „	Mwanza Province ...	118 „

The greater part of estate grown cotton is produced in Kilosa and Morogoro Districts where it is largely interplanted with sisal. With the curtailing of sisal planting, areas of cotton planted in young sisal were automatically reduced and in the Kimamba area, rat infestation and low prices further reduced production. In the two districts mentioned, production fell from 5,888 in 1930 to 1,536 bales in 1931.

The sales of seed-cotton by natives during the 1931 season are shown in the following table :—

Area	In Kilograms				Value
	1st	2nd	3rd	Total	
					Shs.
Morogoro-Kilosa ...	878,711	158,885	187,650	1,225,246	168,188
Rufiji	42,768	1,876	3,074	47,606	7,517
Bagamoyo	77,516	7,584	5,404	90,504	12,601
Dar es Salaam	6,645	1,411	2,365	10,421	1,233
Lindi and Mikindani ...	40,057	4,853	6,668	51,578	5,239
Northern and Tanga Provinces	77,180	8,150	15,338	100,668	9,766
Mwanza Province ...	3,225,886	655,133	—	3,881,019	391,371
Tabora Province ...	60,930	17,593	—	78,523	11,668
Biharamulo	887	437	—	1,324	65

The range of prices paid in the various areas shown in cents of a shilling per kilogram is given in the following table :—

Centre	1st Quality		2nd Quality		3rd Quality	
	Maximum	Minimum	Maximum	Minimum	Maximum	Minimum
Ngerengere	22	18	14	10	10	5
Kilosa	25	15	18	5	6	2
Mikese	20	14	14	7	4	2
Kimamba	28	16	15	5	7	2
Mohoro	18	15	12	9	6	3
Lindi	12	12	8	8	6	6
Mikindani	12	10	8	7	6	5
Mwanza Province ...	16	8	4	2	—	—
Tabora Province... ...	16	8	8	2	—	—
Biharamulo	8	5	2	2	—	—

Cotton Board and Cotton Cess.

The Cotton Advisory Board which includes representatives of the industry from the leading cotton centres has continued to function in an extremely satisfactory manner and all questions of cotton policy have been submitted for the Board's consideration.

The cotton cess which was imposed with a view to effecting payment for cotton seed, transport costs and market supervision has not proved in practice to be entirely satisfactory in the Eastern Province owing to the difficulties of collection.

The question of the future of the cess is a matter which is receiving the consideration of the Cotton Advisory Board. As the final figures of the cess for the season are not yet available, it is not possible to include them in this report.

Coffee.

The exports for 1931 show a drop of 2,300 tons and a decrease of £150,000 in value on the 1930 figures. The season in the Northern Province was a very poor one as far as yield was concerned. About one-third of the exports represented a carry-over from the 1930 season, whilst the carry-over for 1931 will be comparatively small. Low prices were realized in London at the beginning of the season ; the average price for "A" being £60 per ton but later prices improved and an average of £90 per ton was realized.

In the Bukoba area where production is almost entirely native, the season was a good one for Robusta but a poor one for Arabica, the exports of the former showing a slight increase over the 1930 figures, whilst the latter dropped by a thousand tons. Here again prices showed a heavy fall, the average being at Bukoba £26 and £19 for Arabica and Robusta respectively as compared with £35 and £26 per ton in 1930.

The question of the improvement of the coffee crop from Bukoba has been under consideration by this department for some time and the continued decline in quality from this area has moved the main body of sound commercial opinion in favour of Government inspection at the Port of Bukoba. Arrangements are in hand with a view to commencing the inspection and grading of coffee for export at the beginning of the 1932 season.

The coffee plantations in Bukoba despite several years of educative effort and the application of "Coffee Rules" by the Native Authorities, are still in poor condition. It is considered that the construction and use of a much larger number of dipping tanks in the province would react on the condition of the coffee plantings through the establishment of permanent herds of cattle. Competent observers estimate that from existing plantations the output could be practically doubled, did native owners regard the crop as something other than a "wild" culture. A number of men do care for their plots but the vast majority merely harvest the crop paying little or no attention to the culture of the trees. At the present time the Arabica plantings are in jeopardy through this casual attitude. The department views with some alarm the continuance in some Sultanates of the present method used in applying the rules for the better management of the trees, as there it is control but in name.

On Kilimanjaro a far better state of affairs obtains, possibly because of the nearness of many non-native plantations, and many native coffee shambas are continually maintained in prime condition. Large numbers of trees have not yet come into bearing. The proper organization to handle zones and ridges of native coffee has long been examined, as it is obvious that coffee picked from plots with all aspects and from zones varying in height up to extremes of 2,500 feet, fermented in little parcels and then bulked cannot be expected to give a uniform sample. There are methods and systems by the application of which more uniformity could be attained to, but their inauguration awaits a better native organization.

In future native coffee planting should be supported only where it follows a well thought out scheme of cultural work, pest control and factory facilities with registration of growers following the Nyasaland native tobacco plan. In areas where natives are indulging in indiscriminate planting timely action should be taken. With examples before us such as Bukoba, the Pares and Kilimanjaro, there is no question about it.

European coffee planters in many instances are working hard to bring their plantations up to a high standard, a number are handicapped through having assumed too great liabilities in the form of advances against crops which either have not eventuated or when sold could barely pay the interest on the loans made. It is trusted that in future whilst not being over cautious, merchant bankers and coffee brokers will be more circumspect in their competitive pre-crop loan operations.

It is to be noted that excessive and indiscriminate irrigation with waters, the salinity of which is perhaps too high for safety has affected plantations in certain areas, and it is satisfactory to record that planters are being more careful in the use of such water for irrigation. The subject requires still further study by the departmental officers.

The newer coffee areas in Mbeya, Mbosi, Tukuyu, Dabaga and Mufindi, all exhibit peculiarities of their own demanding careful study and management to counteract possible ill effects on the trees.

Considerable advance has been made during the year by departmental officers in the study of coffee problems. It is still possible to record that the Northern and Tanga Provinces are free from *Stephanoderes* and the coffee mealy bug, and every endeavour will be made to maintain the "clean slate".

Attention is called to the inauguration of block spraying on Kilimanjaro where simultaneously over large areas spraying operations are carried out by planters and natives alike.

The projected Coffee Experiment Station for the Northern Province cannot be proceeded with on account of the financial situation.*

The Coffee Advisory Board for the North-Eastern Circle has sat twice during the year.

The figures for production in the chief coffee areas in 1931 and the two previous years were :—

Area	1929 Cwts.	1930 Cwts.	1931 Cwts.
Bukoba	135,880	147,380	131,720
Northern Province ...	37,942	65,820	49,480
Usambara District	2,898	4,140	3,760

The total exports and estimated values of estate and native coffee in 1929, 1930 and 1931 were as follows :—

	1929		1930		1931	
	Cwts.	£	Cwts.	£	Cwts.	£
Estate	29,409	134,709	67,540	165,309	41,320	81,269
Native	147,731	454,162	163,400	231,731	143,700	165,768
Total ...	177,140	588,871	230,940	397,040	185,020	247,037

Tea.

This crop is being developed in the Usambaras, Mufindi and Rungwe areas.

The product has received favourable reports in London, but the industry has not yet reached a stage when exportation on a large scale can be considered. In the Usambaras, where development is most forward, one large estate has 840 acres of tea and expects to pick 100,000 lbs. for the 1932 season.

So far, no tea has been harvested in the Mufindi District and in the Rungwe area only a small acreage is in bearing and manufacture proceeding. Development, however, is being retarded through lack of sufficient capital to provide up-to-date factories and machinery. It is hoped that when financial conditions generally improve that capital for this enterprise will be more readily forthcoming.

It is trusted that the forthcoming visit of Dr. Mann, the well-known tea expert, will result in further attention being paid to the crop and the enterprise of Dr. Weddige in providing a factory for the Mufindi area will arouse further qualified operators to take a financial interest in this new industry.

*Note :—The Scheme has now received the approval of the Secretary of State and funds are being provided.

Sisal.

This fibre continues to show an increase in production and the 50,000-ton mark was passed in 1931 in spite of or perhaps more correctly because of the low prices prevailing. These fell continually from £17 per ton in January to £12 per ton in September, after which there was a rise to £17 10s. per ton. In every direction sisal growers have endeavoured to decrease costs of production and to inaugurate improved and more economical methods of dealing with the crop. Whilst this is all to the good of the industry, it cannot be denied that the future outlook for the trade and concurrently the finances of the Territory is a gloomy one.

The need of greater co-operation between East African sisal interests has been realized by the Tanganyika growers, and the previous local sisal associations in the Territory are now combined to form the Tanganyika Sisal Growers' Association, with headquarters at Tanga. A good deal of work has already been carried out by the new association on all matters pertaining to sisal production, distribution and marketing, as reported in both the local and the home press. The solution of the problems besetting the sisal industry, however, is one that lies beyond purely local action.

Brokers have referred from time to time to the indiscriminate and weak selling for parcels of East African sisal, which is due however to the fact that many producers are indebted to banks and merchant-houses, and are forced to sell their produce as early as possible, often without regard to the state of the market. This further depresses the level of prices and reacts on those producers who are unembarrassed financially, but are obliged to sell at the same unprofitable rates.

Sisal is not graded except by the estate under its own mark. It would be an expensive undertaking to apply a satisfactory and uniform grading system. There are a large number of small sisal estates which are reaching the producing stage, but it is unlikely that funds will be forthcoming for their equipment and the sisal will remain unharvested. This is particularly the case along the Central Railway Line. The department has demonstrated the fact that with dry decortication of leaf no deterioration of fibre occurs for at least six hours. It would therefore be possible for a central washing, centrifuging, drying and baling mill to deal with the produce of a number of estates within a radius of say fifteen miles. In this way also the grading and baling of a large quantity of sisal could take place at a central factory. Until, however, there is some improvement in sisal prospects, there is no chance of the estates being able to acquire a decorticator or of funds being forthcoming for a central factory.

In travelling by air over sisal estates the fact is well observed that areas of sisal are reverting to light bush, fortunately these areas will permit of reclamation in due course.

There has been a movement to establish a factory for the production locally of sacks so much used in agriculture in these territories. The department has sent sisal and tow to New Zealand to be treated by a softening process which may render it of utility in new directions.

The Sisal Experiment Station project is in abeyance for a time on account of financial conditions.

The total value of the crop exported in 1931 was £707,177 as compared to £1,172,315 in 1930. The following are the figures showing the exports for the last three years :—

Area	1929 Tons	1930 Tons	1931 Tons
Tanga	35,313	37,827	38,113
Morogoro-Kilosa-Dar es Salaam	6,279	7,813	9,866
Lindi	2,871	3,319	4,860
Moshi	789	159	1,718
Mikindani	464	781	1,382
Other areas...	12	63	—
Total ...	45,728	49,962	55,939

Tobacco.

The export of tobacco amounted to 314,469 lbs. valued at £3,362. The production of Turkish tobacco in Iringa is developing slowly and the improvement of the native crop by the teaching of fire curing is meeting with success. All fire cured tobacco is absorbed by the local market and the crop is not included in the export figures which refer mainly to common native tobacco.

Tobacco production is not making rapid headway and several years must elapse before either the production of fire cured Virginian or the more difficult Turkish leaf attains to any dimensions. A small experiment station equipped with very temporary buildings has been started at Iheme near Iringa. Should the work on Turkish show greater and continued promise, no doubt much more elaborate and careful experimental work will need to be undertaken.

Groundnuts.

The fall in production in this crop is more marked than any other. From an export of 17,333 tons in 1930 valued at £186,567, the figure dropped in 1931 to 3,070 tons valued at £28,706. The crop was almost a complete failure in the Mwanza-Tabora area, one of the chief centres of production. This is ascribed to the absence of good planting rains. Germination was poor and yields negligible. Planting also decreased as a result of the poor prices offering.

In the Lindi area rosette disease was prevalent in Masasi and in Tunduru, there was a shortage of seed following on the famine in 1930.

Every effort is now being made to stimulate the production of this crop and it is hoped that 1932 will show a return to the successful harvests which were obtained in the past.

Copra.

The tonnage of copra produced for export was maintained at almost the 1930 level, but the value decreased from £109,733 to £62,209. The following table shows the exports for the last three years :—

Area	1929 Tons	1930 Tons	1931 Tons
Tanga-Pangani	2,813	2,972	2,119
Mafia...	1,699	1,619	4,627
Dar es Salaam and Bagamoyo	2,800	2,455	
Kilwa-Mikindani-Lindi ...	608	349	488
Total ...	7,920	7,395	7,234

Attention is continuously directed to the sanitation and to the cultivation of palm groves, but progress is not rapid. The output of copra from existing planting could be much increased and the product improved. Kiln drying is being introduced.

Simsim.

This crop shows an increase over 1930, but the production is still below the 1929 level. It is mainly produced in the Lindi area where it is still a popular crop with the natives. Efforts are being made to increase its production in that area this season and attention is being given to purity of product.

The export figures for the crop are as follows:—

Area	1929 Tons	1930 Tons	1931 Tons
Lindi-Mikindani	2,789	2,106	2,327
Mwanza	478	435	335
Kilwa	447	414	514
Other areas	542	160	649
Total ...	4,256	3,115	3,825

Grains.

The Territory exported 11,794 tons of rice, millet and maize valued at £79,320 during 1931. This shows an increase in quantity over 1930, but a decrease in value of £8,000.

The following are the export figures for the main producing areas:—

Crop and Area	1929 Tons	1930 Tons	1931 Tons
Rice, Mwanza	1,726	3,087	2,571
Millets, Lindi	3,509	1,296	2,182
Maize, Tanga	37	97	277
„ Moshi	*	*	1,311
„ Lindi	323	125	16

*No figures available

Other Crops and Products.

Beeswax.—When produce prices are low and there is a scarcity of money, the native usually pays more attention to the collection of beeswax and exports of this commodity rise. In 1931, 607 tons valued at £47,010 were exported

as compared to a valuation at £30,334 in 1930. Considerable interest is taken in this commodity by the department and it is felt that production could be increased considerably. In addition it is considered to be a possibility to deal direct with the market in Great Britain. At present quite 90 per cent. of our wax is exported to other countries and apparently from those countries some of it finds its way to the London market.

Kapok amounting to 89 tons valued at £4,500 and *Cinchona* bark 6 tons valued at £403 was exported.

Wheat is produced in the southern highlands, but without milling facilities and suitable markets, little can be done with this crop.

Fruit.—Stone fruits are grown with some success in Lushoto, Iringa and Morogoro. Production is small and is absorbed locally.

DETAILS OF ASSISTANCE AND PROGRESS.

North-Eastern Circle.

Northern Province—Tanga Province.

The year under review covers the first completed annual period under circle organization for these provinces and the closer and specialized attention to the particular problems of the area which the organization permits has already proved the value of this measure of decentralization. The Senior Agricultural Officer, whose headquarters are at Moshi, has a field staff of six District Agricultural Officers and two Agricultural Assistants. Of these, two District Agricultural Officers are stationed at Moshi, one responsible for native and one for estate agriculture. The two Agricultural Assistants are employed in the constant supervision of the native coffee crop of Kilimanjaro. Other District Agricultural Officers are posted to Arusha, Lushoto, Tanga and Handeni, the latter station being temporarily filled with a view to improvement in the extent of native cotton production.

The Entomologist is also attached to the Circle and is mainly engaged on investigational and advisory work on coffee pests in the Northern Province. For purposes of economy, further reductions have been made in the African staff who now number 37 as compared with 47 in 1930.

The staff has been concentrated in areas where the agricultural potentialities are greatest while areas of poor possibilities are ignored provided that the food supplies are sufficient for the population. This policy is a direct one of obtaining value for money spent, that is of carrying out work which will result in a substantial contribution to the wealth and resources of the Territory, with such additional protection as can be given to such a vulnerable industry as coffee, and for the general provision of ample food supplies for estates and the native population. In the same way, the District Agricultural Officer concentrates on those areas where crops of economic importance can best be produced, or where the character of the native himself is such that there is an appreciable reaction to propaganda and advice, resulting in outstanding areas where improved methods are in use for the growing of superior varieties of crops which, especially where combined with the sound native practice

learnt by the dire experience of many generations, gradually extend to the surrounding and possibly more backward tribes.

With estate agriculture, it is the aim that each and every estate be visited, that not only an appreciation of every difficulty and problem that may beset the planter be obtained, but also to enable the department to be the liaison between planters for the dissemination of knowledge of good farming practice proved by local experience. Also with certain estates, possibly showing some peculiar problem, a closer touch is kept for more detailed observation in the hope that ameliorative measures may be evolved for general application.

In view of the close proximity of Taveta (Kenya) to Moshi, arrangements have been made with the Director of Agriculture, Nairobi, for this department to assist and advise the planters of that area.

In the Western Usambaras, Moshi and Arusha, the total rainfall was fifteen to twenty per cent. above the average, but the distribution was poor and precipitation over a comparatively short period in April and May. The short rains were also delayed and limited and in Lushoto they actually failed.

In the coastal areas the long rains were abnormally heavy and more prolonged and conditions for plant growth were excellent, with the result that native foodstuffs were abundant.

In noting the effect of the year's rainfall on coffee it is important to remember that the short rains of 1929 were unduly heavy and were carried through almost continuously to the long rains of 1930. Such a continued precipitation was most favourable for the setting of the coffee blossom, but most unfavourable for the necessary aeration of the soil, so that in the 1930 season it became impossible for the plant to feed sufficiently the great amount of cherry which it bore: there were comparatively long periods when denitrification must have occurred, the consequent lack of available nitrogen causing the chlorosis or yellowing of the leaves of the coffee plant, and "die-back" later became rife.

The rains of the period November 1930 to June 1931, the critical period for coffee, were good for the 1931 crop, but as a result of the very heavy bearing experienced in 1930, the coffee trees had not recovered sufficiently to form flower bud, and yields were consequently poor; where overbearing and "die-back" had not occurred in the previous season, the rains were ample to bring out the flower and to ripen the crop.

Sisal.—The following are the amounts of sisal fibre exported during the past three years:—

Province	1929 Tons	1930 Tons	1931 Tons
Tanga	34,542	36,480	38,113
Northern	1,560	1,659	1,718
Total ...	36,102	38,139	39,831

The above amounts were shipped through the ports of Tanga and Kilindini as follows :—

Port	1929 Tons	1930 Tons	1931 Tons
Tanga	35,313	37,728	39,552
Kilindini	789	411	279
Total ...	36,102	38,139	39,831

The manner in which estates have generally maintained production in face of low prices, is seen in the above record figures of the amounts of sisal exported in 1931 ; but the value of the total exports for 1931 was less than half that for the year 1929.

The price of first grade sisal fibre was £17 per ton in January, there was a fairly continuous fall to £12 per ton in September, with a sudden rise to £17 10s. followed the abandonment of the Gold Standard by the Home Government.

The cultural side of sisal production suffered severely from the fall in prices and general world-wide depression : the larger concerns have, however, taken a more prudent course of restricting output and conserving existing plantings. In addition they have evinced their confidence in the industry by replanting old areas and installing improved machinery. A plant for the artificial drying of fibre has been in operation throughout the year on one estate, and has been so successful that other estates will follow suit as soon as the economic conditions show signs of improvement. A few concerns closed down during the year and one company was forced into liquidation.

Coffee.—The production of coffee in the Northern and Tanga Provinces is practically all of the Arabica type, with small amounts of Robusta in the high rainfall areas of the Eastern Usambaras where the conditions have proved unsuitable to Arabica coffee, and in the Nguu Hills of the Handeni District. The Robusta coffee is all sold for local consumption.

The following are the amounts exported over the past three years from the various areas :—

District	1929 Tons	1930 Tons	1931 Tons
Arusha	785	1,418	838
Moshi	1,113	2,674	1,636
Usambaras	144	207	188
Total ...	2,042	4,299	2,662

The amounts were shipped through the ports of Tanga and Kilindini as follows :—

Port	1929 Tons	1930 Tons	1931 Tons
Tanga	1,499	2,498	1,265
Kilindini	543	1,801	1,397
Total ...	2,042	4,299	2,662

The 1931 season was a very poor one as far as yield was concerned. Of the above exports of coffee about an eighth represents a carry-over from the 1930 season, the carry-over from 1931 for export in 1932 will be comparatively small. Low prices were realized in London at the beginning of the season, the average price for A's being about £60 per ton, but with the abandonment of the Gold Standard, combined with a scarcity of mild coffees, the average price increased to £90, while £131 was realized for one Kilimanjaro consignment and £152 was the record price for Arusha (Tengeru) coffee.

Native Coffee.—The areas where native coffee is grown are :—

(i) Kilimanjaro—where there are nearly 13,000 native growers of Arabica coffee, owning about six million trees of which some three and a half million are in bearing. These growers are all members of the Kilimanjaro Native Planters' Association.

(ii) Arusha—where on the slopes of Meru there are about 700 native Arabica coffee growers who also have an association which, however, is one merely in name.

(iii) In the Pare Hills—356 natives, against the advice of this department, planted Arabica coffee some few years ago but the conditions proved entirely unsuitable and many are now uprooting their coffee and returning to cotton planting in the plains. The growers are nominally affiliated to the Kilimanjaro Native Planters' Association.

(iv) In the Western Usambaras—the number of native growers of Arabica coffee has increased from 200 in 1929 to nearly 500 in 1930.

(v) In the Eastern Usambaras of high rainfall—there are 94 native planters of Robusta coffee, while there is a small number of such growers in the Nguu Hills of the Handeni District.

(vi) In Mbulu District—there are 31 native growers of Arabica coffee whose plots are all considerably larger than the average found on Meru or Kilimanjaro.

The close attention given to native coffee is seen in the following table of inspections carried out over the past two years by the District Agricultural Officers, and their Agricultural Assistants. Wherever possible, the closest co-operation is maintained with Native Authorities and the Native Planters' Associations in this work :—

	Arusha		Moshi	
	1930	1931	1930	1931
Number of Growers	700	700	12,500	12,500
„ of Inspections	1,217	744	14,798	21,847
Written orders given	71	141	566	1,688
Prosecutions	11	32	77	60
Plots uprooted	1	—	4	7

In addition to the 1931 season being a poor one as regards yield, it has been an unfortunate one as regards the marketing of the crop. Mr. Harvey, the District Agricultural Officer in charge of native agriculture on Kilimanjaro reports : "The greater part of the 1931-32 crop is being purchased outright by licenced buyers in competition with the Kilimanjaro Native Planters' Association. The buyers now number twenty-one and competition is so strong that the marketing of the crop has developed into an undignified scramble, with scouts of the various buyers patrolling streets and cross roads

in and around Moshi to waylay growers. Conditions such as these are conducive to irregularities. Indiscriminate buying without reference to quality is direct encouragement to careless preparation and, later, adulteration. Slackness at any stage leads to slackness elsewhere: careless preparation is followed by neglect of cultivation, and finally the spread of pests. Consignments have been examined this season which were definitely musty, with beans covered with saphrophytic growth. One large consignment (from the principal Moshi buyer) arrived at Kilindini too wet to clean, and the following consignment had to be unbagged and dried at Moshi before despatch. Lack of control over the marketing of the crop will undo the educational work of years. Not only the good name of native coffee, but of Kilimanjaro coffee generally is concerned, since it is known that some consignments of native coffee have been sent home as plantation produce. The native coffee industry had the advantage that for the first few years of its growth the grading and marketing of the crop was in the hands of the Agricultural Department, and it is interesting to note that at the early sales of the 1927-28 season Kilimanjaro Native Planters' Association's coffee sold at the highest figure (£129) in competition with plantation coffee. There is real danger that this initial advantage will now be thrown away. With the example of the Bukoba industry the present trend of affairs is deserving of strong comment."

Despite the poor preparation which was outstanding in the past season, some consignments have been surprisingly good, one gave 75 per cent. A's, which would be considered high for estate coffee, three consecutive consignments realized £99, £94 and £100 for A, £73, £65 and £79 for B and £40 and £60 for C respectively. The price paid by the local buyer was 27 cents per pound or 60 cents per kilogram for the first quality parchment, an arbitrary deduction being made for lower qualities. In December 75 cents per kilogram was paid.

The District Agricultural Officer (Native), and the prospective manager of the Kilimanjaro Native Planters' Association, with members of the Association and African Instructors visited the Kilindini Coffee Cleaning and Curing works, where native and other coffee was seen in the various processes of cleaning, grading, etc., and defects and the causes thereof were pointed out. Following this and the propaganda continuously carried out by this department an increasing number of growers are asking that the crop be marketed separately by ridges in order that the advantages of better production and preparation be secured to progressive sections of growers. The establishment of collecting stations on the various ridges and their possible development into central pulperies has been examined: both will be inevitable finally.

It must be noted that the Kilimanjaro Native Planters' Association has been of little or no use to the department in the work for cultural improvement, neither have they been satisfactorily equipped with sprayer pumps and chemicals to deal with coffee pests and diseases. But as a result of representations a first order has been placed for fifty pumps of the new design approved by the Entomologist to allow of triple-strength spraying for Antestia control, and fifty bucket-pumps for thrips. The Association is being reorganized, and with the additional powers which will accrue to it under the new Co-operative Societies Ordinance, it is anticipated that satisfactory services will be given by the association for cultural improvement, adequate pest control and a sane system of marketing.

Natives co-operated in the intensive large scale control-measures instituted in the "block-sprayings" for Antestia. An intensive campaign was also followed for borer (Anthores), when with 769 plots in the borer belt over 43,000 borer-grubs were destroyed and 17,985 coffee trees were uprooted or stumped, and burned, because of heavy borer infestation. A thorough clean up was effected. The manner in which the native grower has accepted the measures taken for pest control, indicates the extent of his appreciation of the danger from pests and diseases.

In dealing with the question of coffee culture, the Senior Agricultural Officer reports :—

"Careful observations in the field have been made on coffee trees under varying conditions, while investigations and experimental work in other countries both on coffee and all other crops and especially other fruit trees has been followed and carefully examined in order to determine any analogies which may exist with coffee. Mr. F. R. Sanders' work in this respect deserves especial mention. The absence of an experimental station has been a great handicap, for without the opportunity for detailed anatomical and physiological study little definite progress can be made ; nevertheless, we feel that we have advanced to a position where seemingly correct analogies can be put forward to explain some of the problems of coffee-culture in the Northern Province and possibly elsewhere, on which hitherto there has been a discreet silence. A pamphlet on these matters is being prepared, not because it is considered that we have reached infallible conclusions, an experimental station is necessary to provide indisputable data, but in the hope that it will lead planters and others on to new lines of thought, trial or investigation. Here the various problems are briefly described below.

"In the past two or three seasons more has been heard of overbearing and "die-back" with coffee in the Northern Province than ever before. Work carried out by the Mysore Department of Agriculture shows that a heavy crop of 1,200 lbs. of clean coffee per acre removes from the soil 27 lbs. of nitrogen, 5 lbs. of phosphoric acid and 24 lbs. of potash, further but 60 per cent. of the available nitrogen, 10 per cent. of the soluble phosphoric acid and 50 per cent. of the potash applied is absorbed by the crop. In temperate climates, manures act best when the ratio of nitrogen to phosphoric acid is 1 : 3, but 2 : 3 is considered best for the tropics. Hence the manurial requirements of a 1,200 lb. crop will be :—

Nitrogen	... ...	50 lbs.
Phosphoric Acid	...	75 ,,
Potash ...	... ...	100 ,,

"On the majority of estates much more plant food has been lost by soil erosion than is taken up by the crop, and if the planter will reflect and calculate what has been taken out of his soil and what he has put back, he cannot wonder that his trees are easily affected by cropping alone, and rendered very susceptible to pests and diseases. It can be stated, that generally speaking, soil impoverishment is the direct cause of many evils of coffee growing ; the alternate-year-bearing so commonly seen is not inherent in the coffee tree but is largely due to the nutritive capacity of the soil. It must not be considered that the extravagant

application of artificials alone will restore fertility, this is at any rate a costly proceeding, the humus content of the soil must first be increased, and this can be done most economically by green-manuring: the sure foundation of plantation farming in the tropics. The yield of green manures is increased by an application of phosphates to the cover-crops."

Tea.—In the high rainfall areas of the Usambaras, where Arabica coffee has not proved an unqualified success, and the price of Robusta coffee renders this crop unprofitable for plantation enterprise, tea has proved eminently suitable. One large estate has 840 acres of the crop and expects to pick up to 100,000 lbs. in the 1932 season, the product has received favourable report in London. There are other small areas under this crop and it is obvious that the industry could be considerably extended.

Cacao.—Cacao of a very superior quality is grown at the Sigi Segoma Estate, Tanga. It is partly of the Criollo type and enquiries have been made by home firms as to the possibility of increasing production. There is room for extension in the valleys in the vicinity of Segoma at least.

Maize.—During the past decade maize has been imported into the Territory in very large amounts. The imports into the Northern Province in 1930, amounted to 1,202 tons of maize grain and 508 tons of maize flour, representing an efflux of money from the Territory when a greater circulation within its borders is so necessary. This matter has received prolonged consideration, and steps have been taken which it is hoped will prevent the importation of poor quality and often unwholesome maize from adjoining territories. For the year 1931, it is encouraging to record that 1,693 tons of maize were exported from the Moshi District alone, while less than 10 tons were imported; 188 tons were exported from the Arusha District. The Western Usambaras is capable of a large native production of good quality maize, and a surplus of 432 tons was produced for consumption in the Tanga District, a figure practically twice that of any previous years; 12 tons of Potchefstroom Pearl maize seed was distributed in this area in 1931.

Cotton.—Cotton has not been an important cash crop to the Northern and Tanga Provinces in comparison with other products, but there are good possibilities for Handeni and the Pares, where an intensive campaign was instituted towards the end of the year. The output of cotton-lint in 1931 by the ginneries of Mzundu and Kwangero in the Tanga Province and of Himu in the Northern Province is as follows:—

Province	1929 lbs.	1930 lbs.	1931 lbs.
Tanga	127,199	68,574	6,777
Northern	37,342	52,650	13,615*
Total ...	164,541	121,224	20,392

There was a non-native production of 10 tons of seed-cotton in the Pares from cotton intersown with sisal and five tons in the Moshi District.

*Ginning only began towards the end of December and most of the 1931 crop of 90 tons of seed-cotton will be ginned in January, 1932.

Copra.—This product is produced mostly by natives along the coastal belt of the Moa, Tanga and Pangani areas, there are also large Indian and Arab owned coconut plantations. The bulk of the copra is sent to Zanzibar, but some is used for soap-making in Mombasa. Improvement in the sanitation of the plantations has been achieved under the Plant Pest and Disease (Coconut) Regulations during the year, but a great deal remains to be done with this and in the actual preparation of copra. The exports of copra show a large decrease due to poor prices, the amounts being as follows:—

1931	...	...	2,119 tons.
1930	...	...	5,580 ,,
1929	...	...	3,857 ,,

Potatoes.—The Western Usambaras is the best potato growing area; but the market is limited to local requirements which previously have been met from Kenya, but increasing amounts of local potatoes are coming on to the market. 165 tons were railed to Tanga from the Usambaras during the year while but 13 tons were imported. The imports into Moshi were 8 tons only. Seed of Kerrs Pink and Great Scott varieties was imported from Scotland, from which seven tons of seed have been distributed to estates, and further seed-multiplication is being made. Growers should note that potatoes grown on irrigated land become badly attacked by eelworm.

Onions.—In 1930, 138 tons of onions to a value of over £1,000 were imported into Tanga, the figure was 118 tons for 1931. The Northern Province is capable of meeting all the requirements of Tanganyika, which are mostly now met from India and Egypt. The local varieties are equal in keeping and other qualities to the Indian grown, but a little inferior to Egyptian, seed of which has been obtained for multiplication. Bermudan seed is also being obtained. 158 tons of onions were exported from Moshi via the Kenya-Uganda Railway in 1931, the export period being from August to March, while three tons only were imported during April to July. Twenty tons were railed to Tanga.

Kapok.—The greatest production of kapok occurs in the Eastern Usambaras, where new plantings have been made. The exports amounted to 67 tons for the year 1931, compared with 38 tons in 1930 and 85 tons in 1929. The fibre is readily a cylindrical air-container, and a grower has proved that too great a density of the bale for export results in a rupture of this minute air-container and the kapok then loses its value.

Cinchona.—The three species of *Cinchona*: *Succirubra*, *Officinalis* and *Ledgeriana*, are grown successfully in the Usambaras. One estate yearly exports six tons of bark to London, which bark commands satisfactory prices.

Spices, etc.—Vanilla, cinnamon and nutmegs all grow satisfactorily in the Eastern Usambaras. The production of spices could be widely extended to meet at least some of the spices imported annually to the extent of over £10,000. Pepper is grown successfully on a few estates, and is sold locally, there being a good native demand for it during the month of Ramadhan. Cardamons grow wild in the Usambaras, and seed of the Mysore type has been imported but no germination has resulted; rhizomes are now being obtained from India.

Essential Oils.—(i) A sample of "Petit-grain" oil distilled in the Tanga District from leaves of the Seville-orange tree, was sent to the Imperial Institute and received most favourable report being valued at Shs. 8/75 per pound in comparison to Shs. 6/50 for the oil from the main producing country of Paraguay; ecquellor-oil can be obtained from the fruit by hand. It is a possible side line to some sisal estates, one of which with 70,000 bearing trees is considering the production of both oils on a large scale.

(ii) Peppermint oil from plants supplied by the Imperial Institute through this department is being produced on a small scale in Arusha. The quality of the oil so far has not been good.

(iii) Two planters have displayed considerable interest in the production of essential oils and the following plants have been obtained from the Royal Botanic Gardens, Kew, for trial, multiplication and distribution: Peppermints, *Rosmarinus Pyramidalis*, *Melaleuca leucadendron*, *Pelargonium radula-roseum* and *Pogostemon patchouli*.

Tung Oil.—No good or even encouraging results have been obtained yet with Tung oil.

Fruit.—(i) Stone fruits, apples and strawberries do well in the Western Usambaras, excellent grapes are also produced in the Arusha District. All fruits are sold locally and the supply is not equal to the demand.

(ii) In Handeni, a new factory is engaged in the production of dried or "fig" bananas; the product is excellent but should be packed in sealed tins for export.

(iii) Round Muhesa in the Tanga District there is a considerable native citrus industry which is capable of improvement and wide extension. A citrus demonstration plot exists at Muhesa where ten imported varieties of oranges, naartje, grape-fruit and lemons are grown on terraces. Stocks of rough lemon are budded for distribution and it will soon be possible to supply budding-material for natives and others as required.

North-Western Circle.

Mwanza Province—Tabora Province—Bukoba Province.

This Circle, comprising three of the richest producing and thickly populated provinces in the Territory covers a wide area and is one requiring an adequate staff. Efforts have been directed towards a proper provision in this respect, officers being stationed in all the main producing areas. The staff under a Senior Agricultural Officer stationed at Mwanza consists of seven District Agricultural Officers and five Agricultural Assistants, posted to Mwanza, Kwimba, Maswa, Musoma, Shinyanga, Nzega, Bukoba and Biharamulo Districts.

The year under review has been a depressing one and it closed with a heavy infestation of locusts in the Tabora and Mwanza Provinces, where a large scale campaign against hoppers was in progress. At the same time, every effort has been made to stimulate production by increased planting and provided that the crops do not suffer unduly from the locusts, the outlook for 1932 is much brighter. In this connection, the Senior Agricultural Officer, reports:—

"The year has been marked by changes. The Agricultural Officer felt that he was ploughing a lone furrow and watched a fall off in the

production of cash crops, a decrease in the acreage under cultivation, and a tendency on the part of the natives to reduce their planting still further while he felt powerless to prevent it. Some areas which once had produced nearly 1,000 tons of cotton produced under 100 tons. Bukoba coffee export figures dropped by 1,000 tons: rice from 14,000 to 10,000 tons and a record groundnut crop estimated at 23,000 tons fell to about 5,000 tons. He witnessed the results of years of hard work and propaganda slowly but surely dwindling away and realized that all his efforts were to be nullified unless some means were devised to overcome the natural consequences of low prices, poor rains, locusts and all that went to make the agricultural depression a fact. Then came the Government's policy of increased production and the cloud of depression lifted. Agricultural Officers entered the field with light hearts only too willing to place their experience and knowledge at the disposal of the Administration. The response of the natives has been marvellous and everything points to a record season from this year's plantings."

An agricultural experimental station and a seed raising farm is maintained at Shinyanga. A separate report on its working forms an annexure to this report (see Annexure VIII). The experiments of previous years have been continued, but more work is being carried out in selections from local types of sorghums, millets and grains.

Ploughs were first introduced on a large scale for native agriculture in 1923-24 and schools were established for instruction and the training of oxen. The results have been disappointing as is shown by the following extract from the Senior Agricultural Officer's report :—

"*Ploughing*.—The first introduction of ploughs on a large scale took place in 1923-24. Ploughing schools were established in all districts where ploughs were introduced. Large numbers of natives received instruction in ploughing and in the preparation of hides for reins and strops, and large numbers of oxen were trained. The results of years of hard work and propaganda have been unsatisfactory. Ploughs are only used by a few chiefs and headmen and a very few natives. At the present stage of agricultural development I do not consider that ploughs are either essential or beneficial to the individual native cultivator. In the process of time some natives will become 'farmers' in the true sense of the word and the plough will then come into its own. The native reply might well be quoted to show the social point of view: 'At the present time our wives create enough trouble and if they had not the fields to hoe, we don't know what would happen.' The average native cultivator is really a gardener and it is well nigh impossible to convince him that the increased acreage he would get by using a plough justifies the initial expenditure, the cost of upkeep and the risk of losing his cattle. Trials are being carried out with a simple form of wooden plough with an iron point. It can be drawn by two oxen and worked by one man. Made locally, it costs about Shs. 12 -. Its work is equal to that done by a native hoe but is much quicker. Time is an important factor and it is hoped that this cheap and simple implement will find more immediate favour with the natives, and that in due course they will turn to more expensive and efficient implements."

Coffee, which is almost entirely produced in Bukoba District, produced a crop of approximately 6,600 tons, but considering the reluctance of the natives to pick and sell their crop at the present low prices, the latter figure cannot be taken as representing the total yield. The following table gives the exports of Bukoba coffee for the last nine years :—

Year	Robusta Tons	Arabica Tons	Total Tons	Value £
1923	1,673	887	2,560	116,678
1924	2,869	662	3,531	234,026
1925	2,578	1,573	4,151	320,745
1926	3,579	1,071	4,650	324,094
1927	2,569	1,375	3,944	215,844
1928	5,254	2,583	7,837	478,311
1929	4,721	2,073	6,794	400,011
1930	4,660	2,706	7,366	194,010
1931	4,848	1,738	6,586	133,260

In the Bugufi division of the Biharamulo District, with strong administrative support the development of coffee growing has progressed rapidly during the year and coffee nurseries have been established in all villages in the coffee belt.

Cotton.—The main cotton producing areas lie in the Lake Basin. The type of cotton at present grown is "Uganda Upland". The average yield even in normal years is low, the best plantations producing not more than 400 lbs. per acre. Further trials with the U/4/4/2 type introduced from Barberton, South Africa, were carried out in all cotton growing areas and over 100 acres were planted at Ibadakuli for the propagation of seed.

The results of the trials were as follows :—

District	Place	Yield in lbs. per acre
Shinyanga	Lubaga	976
	Experimental Station ...	466
Mwanza	Ukiriguru	273
Kwimba	Manthare...	305
	Ngudu	272
Maswa	Sengerema	147
	Shanwa	129
	Nassa (Lake Basin) ...	500
Biharamulo	Kigombe	171

Mr. S. Milligan, of the Empire Cotton Growing Corporation, examined the conditions under which U/4/4/2 cotton was being grown. He was pleased with the behaviour of the U/4/4/2 at Lubaga, Ibadakuli, Ukiriguru, Manthare and Ngudu but expressed the opinion that at Lubaga quality had been sacrificed for a large yield, there being insufficient moisture to finish off and strengthen the staple.

Cotton in the Biharamulo, Kahama and Nzega Districts proved a failure. The total cotton production was as follows :—

Province	1st Quality lbs.	2nd Quality lbs.	Total lbs.
Tabora	—	—	172,861
Mwanza	7,165,031	1,516,960	8,681,991
Bukoba	1,954	962	2,916

The range of prices per pound were as follows :—

Province	1st Quality		2nd Quality	
	Maximum	Minimum	Maximum	Minimum
Tabora	8 ...	4 ...	4 ...	1
Mwanza	8 ...	4 ...	2 ...	1
Bukoba	4 ...	2½ ...	1 ...	1

The total crop produced 7,011 bales.

Groundnuts, the principal cash crop, is always popular with natives and the fact that increased yields are obtained when it is grown as a pure crop, correctly spaced, is being realized in many areas. Unfortunately, the low prices prevailing the previous season and the poor rains had disastrous effects on production, which fell from 8,614 tons in 1930 to 3,256 tons in 1931.

Rice.—This crop was estimated at 800 tons in 1907 and rose to an estimated production of 14,000 tons in 1930, of which 6,000 tons were exported. Owing to locust and adverse conditions, the export in 1931 dropped to 3,987 tons. Selections and trials of local varieties are being carried out in Musoma and attention is being paid to the propagation of the Bungala variety.

Sesame showed an increased production and 1,367 tons were exported.

Tobacco.—The results of tobacco trials in Biharamulo have proved to satisfaction and the Heavy Western type has shown a yield of 400 lbs. per acre. Great difficulty has been experienced in finding a suitable cash crop for Kibondo and the sleeping sickness concentrations of Kahama. Tobacco offers fair promise and it is proposed to extend its cultivation to those districts. First and second grades of fire-cured tobacco sell in Dar es Salaam at Shs. 1/50 and Sh. 1/- per kg. as compared with 50 cents per kg. for the ordinary native tobacco sold locally in rolls.

South-Eastern Circle.

Lindi Province—Mahenge Province.

Lindi Province and the Songea District of the Mahenge Province are incorporated for departmental purposes under a Senior Agricultural Officer stationed at Lindi with a field staff of three District Agricultural Officers and one Agricultural Assistant stationed respectively at Lindi, Songea, Masasi and Mikindani (Mpapura). The African staff, as elsewhere, was reduced.

Generally, the rains were late over the whole area and on the coastal belt the rainfall was high but localized and erratic. In the coastal area, grain crops were poor, but fortunately there was a bumper crop in 1930 resulting in a carry-over to 1931 and this is largely reflected in the increased export figures for the year. Swamp rice and simsim crops were good and in the inland districts crops were up to the average standard. Some progress was made with tobacco in Songea, Masasi and Tunduru. As cash crops, simsim, rice and tobacco are increasing in popularity whilst cotton is becoming less attractive. Although the volume of exports has increased as compared with 1930, the value has fallen from £178,564 to £157,925, the decrease being mainly due to the fall in the price of sisal. The following are the comparative figures for 1930 and 1931 :—

	1930 Tons	1931 Tons	Increase Per cent.
Sisal	4,099	6,242	54
Sesame	2,515	2,841	13
Mtama	1,520	3,531	132
Rice	992	1,211	22
Beeswax...	44	78	75
Copra	349	488	40
Groundnuts	524	375	Decrease
Tobacco	77	120	55
Gum Copal	25	36	44
Cotton	162	34	Decrease

Sisal.—No estates were closed down during the year but reductions in staff and wages were general. The output of fibre was considerably greater than in 1930, but was insufficient to maintain the 1930 level of value.

Simsim, the leading native export crop, shows a slight increase over the 1930 crop. Reports indicate that a further substantial increase in this product may be anticipated. Efforts have been made to maintain the quality of the "Lindi White" simsim and seed has been multiplied on the Mwera Tribal Farm and the Mpapura Experimental Station.

Beeswax.—In general with the rest of the Territory beeswax shows an increase from 44 tons in 1930 to 78 tons in 1931. The low price for field produce tends to stimulate the collection of beeswax, which in value now exceeds copra, groundnuts, tobacco and cotton.

Tobacco exports have increased from 13 tons in 1927 to 120 tons in 1931. The bulk of this is native roll tobacco and is produced in Songea and Tunduru.

An effort is being made to teach the natives to produce a better class of tobacco and the Heavy Western variety has been introduced from Nyasaland. The marketing of the product is being undertaken by the department and natives are being trained in growing and in fire-curing.

Cotton.—The cotton production figures are extremely disappointing, production having dropped from 897 tons in 1925, when prices were high, to 57 tons in 1931.

The District Agricultural Officer, Lindi-Mikindani, reports as follows:—

"In 1930 there was a greater estimated acreage of cotton than in 1929 but as previously reported a large part of the crop was left unpicked. The acreage in 1931 was estimated at rather less than one-third of that for 1930, but unpicked cotton was still more common than in the previous year in spite of the efforts made to induce the natives to save the crop. The 'rot' is obviously taking its course in a very much more decided fashion than after the drop of 1926 and unless some direct action is possible, the prospects for 1932 are discouraging. It is not considered likely that the present cash crop campaign will affect cotton production to any considerable extent. It will probably check the decline, but increases in production are more likely to be reflected in the simsim and rice crops."

Eastern Province.

During the year, the province was served by the following agricultural staff: one District Agricultural Officer stationed at Mpanganya Experimental

Station for the Rufiji District: one at Morogoro assisted by an Agricultural Assistant whose duties were mainly in connection with the experimental station. Mr. T. H. Marshall, the Head Gardener, attached to the headquarters staff, who is a horticultural specialist, took over the permanent plantings of the experimental station with a view to the propagation of fruit trees and the regeneration of the orchards. Financial considerations necessitated the reduction of the African staff from seventeen to fourteen in the Morogoro and Kilosa Districts and eighteen to thirteen in the Rufiji District. The rainfall was the highest for the last thirteen years causing some little flood damage in the Rufiji.

In the Morogoro-Kilosa area weather conditions were normal and growing conditions for crops excellent. There was, however, a large fall in cotton production, both native and non-native, following on the fall in price during 1930 and reduction in acreage in the large non-native area of Kimamba. Natives were slow to make their first pickings when the price of cotton was at its lowest and great pressure was necessary to induce them to pick when it rose. Consequently, much cotton left unpicked was lost by the depredations of an infestation of field mice. Low prices were also responsible for a lack of interest by the natives in grading, the difference in price between the first and second qualities being too small to encourage selection. If the quality of the crop is not to deteriorate, the maintenance of the first grade for seed purposes is of paramount importance, and this question is a matter which will require the attention of both this department and ginners in 1932.

The output of lint from the Morogoro-Kilosa area declined from 8,129 bales in 1930 to 3,685 bales in 1931. Of this, 1,536 bales were of estate production which showed a decline of 52 per cent. on 1930.

The production of native seed-cotton in the main areas was as follows:—

District	1st Quality Kgs.	2nd Quality Kgs.	3rd Quality Kgs.	Total Kgs.	Value Shs.
Kilosa	345,465	61,752	82,949	490,166	74,301
Morogoro ...	533,246	97,133	104,701	735,080	93,887
Rufiji	42,768	1,916	3,074	47,758	7,517
Total ...	921,479	160,801	190,724	1,273,004	175,705

A very noticeable feature of the cotton season in the Kilosa and Morogoro Districts this year, was the export of seed-cotton to Ruvu Ginnery. The figures in kilogrammes of seed-cotton are given below:—

From	1st Quality	2nd Quality	3rd Quality	Non-native	Total
Kilosa	77,552	4,943	16,263	63,457	162,215
Morogoro	242,600	24,545	33,750	119,578	420,473
Total ...	320,152	29,488	50,013	183,035	582,688

The heavy fall in cotton prices is illustrated by the following comparative table showing the prices paid at four buying centres for first quality seed-cotton :—

Centre	1930 Maximum cents per kilo.	1930 Minimum cents per kilo.	1931 Maximum cents per kilo.	1931 Minimum cents per kilo.
Morogoro ...	30	25	18	11
Turiani ...	30	16	20	8
Kilosa ...	32	21	25	15
Kimamba ...	35	20	28	16

Sisal.—The uncertainty of the sisal market caused a severe set back to the crop during 1931. Practically all planting was stopped and cultivations were reduced to a minimum so that much good sisal, and much young sisal went back to bush. In the Kimamba area, estates which had planted cotton in their young sisal and thereby paid for their clearing operations, did not plant because of rats so that the sisal suffered from dirty field conditions. Some factories which continued to produce were working very often only three or four days a week. As a result of these discouraging conditions, the export of sisal from Morogoro fell by nearly one-third during the year. There are now several abandoned areas of sisal in the two districts of Morogoro and Kilosa, mainly small estates with sisal ready for cutting, but the owners are unable to afford to erect factories. Should conditions improve, it is considered that where several such small shambas lie adjacent to one another, it would be better if a large co-operative factory were erected than several small ones with their duplicated overhead charges.

Potatoes.—The improvement of the potato industry has received an increased amount of attention and new seed has been introduced and distributed with a view to the improvement of quality. The export of this commodity from the Morogoro District has increased from 43 tons in 1930 to 52 tons in 1931.

Iringa Province.

The province is staffed by a District Agricultural Officer and an Agricultural Assistant stationed in Iringa District, and a District Agricultural Officer in charge of the south-western area assisted by an Agricultural Assistant stationed at Tukuyu. The District Agricultural Officer, Iringa, is largely employed in the fostering and improvement of the tobacco industry and the District Agricultural Officer of the south-western area in that of tea and coffee.

Weather conditions in Iringa were not particularly favourable to crops, the normal amount of rain falling but spread over a shorter period. In other parts of the province, rain was more evenly distributed and growing conditions better.

The general fostering of the tobacco crop and the establishment of the embryo Turkish industry in Iringa continues to receive the keen attention of the department. A permanent experiment station site has been selected at Iheme where fertilizer trials of Turkish tobacco are being undertaken. Variety trials of four varieties of Virginia tobacco and twenty of Turkish tobacco are also being commenced. A temporary Turkish tobacco magazine has been built to assist planters by the fermentation of the crop prior to export and a curing barn for Virginia tobacco is in course of erection.

Following the opening of two small tobacco factories in Dar es Salaam, it is estimated that 10,000 pounds of Virginia dark fire-cured leaf have been exported from the district for manufacture. The factories in question are concentrating on the manufacture of shag tobacco and little is being done by them in the manufacture of Turkish tobacco. This crop is being fermented and prepared for export by the department and one hundred and nine bales are now being prepared for export in 1932. This comprises the 1931 crop and is an increase of twenty bales over the previous crop.

Neither tea nor coffee has yet been harvested in the Mufindi District. A small crop of coffee should be obtained in 1932 and tea probably in 1933. In Rungwe, a small acreage of tea is in bearing and the crop has been manufactured. A limited quantity of coffee has been imported from the Mbeya District and Mbosi is expected to produce in 1932.

In order to encourage tea growing in Rungwe, forty-one maunds of free seed have been issued. It has given satisfactory germination and the plants are even as to type. Difficulty is being experienced owing to lack of capital and in the circumstances little development is to be expected. One estate only has been under cultivation long enough to produce and its tea has been the subject of promising reports. Labour presents a difficulty as it is not easy to obtain in sufficient quantity and is never resident long enough to become skilled.

Arabian coffee in Mufindi has now reached an acreage of 800 acres spread over thirty-five plantations. Three hundred and fifty acres having been planted during the year.

Central Province.

The Central Province is staffed by two District Agricultural Officers, one stationed at Singida responsible for the Singida, Mkalama and Manyoni Districts and one at Dodoma in charge of Dodoma and Kondoa-Irangi Districts.

As in other provinces, it has been necessary further to reduce the African staff which in the Singida area now numbers seven and in Dodoma, three.

In the Singida area, rainfall was abnormally heavy and considerably above the average for the past ten years, whilst in Dodoma the rainfall was the lowest since 1928 and conditions were not conducive to the production of high yields. The natives of the province are mainly pastoral people who aim to cultivate land sufficient only for their needs and this factor makes ameliorative work in agriculture difficult and slow progress apart from the fact that the general soil and climatic conditions are such as limit the choice of crops to sorghums and millets to a predominant degree with maize, groundnuts, beans and pulses and rice as minor crops confined to suitable areas. As a comment on the difficulties of assisting agriculture amongst a pastoral people, the following extract from the report of the District Agricultural Officer, Singida, is of interest :—

> "The sub-stations have generally produced satisfactory yields of the main crops grown, that is those better varieties of their food crops introduced for the purpose of superseding the native varieties of grain as far as possible and such crops as groundnuts and Morogoro cow-peas. But

it is disappointing to record that when some outlying districts or the areas of lesser jumbes have been visited one has often found little or no evidence that issues of seed have been properly utilized and one's questions and requests to see the harvests have been met with evasions and excuses for failure which would require a credulous mind to accept. To what extent it is advisable to take steps to insist that those who accept seed are responsible for its proper cultivation, and what action should be taken with delinquents is a somewhat difficult problem, as undue severity may tend to destroy all ameliorative work which is entirely dependent on goodwill and the cultivating of confidence in the department and its officials."

In Dodoma, possibly due to the fact that the people there have been in closer touch with trading centres and markets, the people are a little more progressive. A general improvement is reported and there has been response to the campaign for greater production. In this connection, consideration has been given to all circumstances with a view to obtaining, issuing and propagating for future issue seeds of such crops as will give satisfactory returns, e.g. white simsim, Ghunti and Korongo rice, cassava, castor oil and groundnuts. The District Agricultural Officer, Dodoma, in referring to native agriculture, states :—

"On touring the area and when conversing with the native on agricultural matters, one comes to the conclusion that the area under crop here is not yielding up to its full capacity nor are the soil and other factors, necessary and available for good production, being utilized in anything like an economical way, steps have therefore been taken to rectify this and the benefits of thorough primary cultivation, manuring properly, rotations, the use of legumes in a crop system, interplanting, intercultivation and mulching, the selection of seed, etc., has been carefully gone into and emphasized. Progress has, of necessity, been slow and cautious as it is desired to get the 'feel' of the native mind and thoughts on such matters prior to becoming too emphatic or forceful in propaganda and educational work regarding them, the object being the adaptation and adoption, where profitable, of established customs and their incorporation with newer and better methods which have proved successful."

Bulrush millet being the chief native food crop, attention has been given to its improvement and the awned variety is being multiplied at sub-stations and work commenced with a view to establishing a pure line. Sorghums are the second most widely grown crop and of the introduced varieties, Bonganhilo has given the best results and is now being multiplied on a large scale. Groundnuts are the main economic crop and further production is being encouraged with vigour. Large free issues of seed have been made and it is hoped that the area cultivated will be considerably extended in the Singida and Mkalama Districts. There is sufficient suitable land available for rice growing in Singida for it to become an important crop and a start has been made by the distribution of free seed in suitable areas and instruction in methods of cultivation.

Beans and pulses are receiving special attention and the Morogoro cow-pea, which has proved a success and is popular amongst natives, is being multiplied as extensively as possible.

Kigoma Province.

This province is staffed by a District Agricultural Officer stationed in Kasulu and an Agricultural Assistant in Ufipa. The former proceeded on leave during the year and the latter was transferred to Kasulu to take over his duties. One Asiatic overseer and eleven African instructors complete the staff.

Rains were irregular in Ufipa, short in Kibondo and heavier than usual in Kasulu. Average crops were produced except in Kibondo where there was a shortage. The planting of Robusta coffee in this area by natives has not been a success and it is questionable whether Arabica of which 1,500 seedlings have been distributed will be suitable either. The suitability of this type for native cultivation on a large scale cannot finally be ascertained until the plant has been tried under the cultural conditions on the average native holding.

The planting of cotton in Ufipa was not attended by success. Only 293 acres were put under cultivation and much was late planted. The crop marketed was 26,000 pounds. Owing to the low prices offered and the indifferent marketing methods of the buyer, crops on many plots were not harvested and in many cases, when harvested, were not marketed.

The introduction and multiplication on the seed farms of the following varieties has been carried out with success: White Kidney, Canadian Wonder, Gotani and Madagascar butter bean, Virginia Bunch groundnuts and Potchefstroom Pearl maize.

E. Harrison,
Director of Agriculture.

30th March, 1932.

ANNEXURE I.

ANNUAL REVIEW OF THE NORTH-EASTERN CIRCLE FOR THE YEAR 1931.

Staff.

1. The European staff of the North-Eastern Circle which includes both the Northern and Tanga Provinces, as on 31st December, 1931, consisted of one Senior Agricultural Officer, six District Agricultural Officers, two Agricultural Assistants, and the Entomologist.

2. The Entomologist was mainly concentrated on investigational and advisory work on coffee pests in the Northern Province. One District Agricultural Officer was responsible for native agriculture in the Moshi District and more especially with native coffee, the other District Agricultural Officer was responsible for estate agriculture, especially coffee, in the Moshi District. The Agricultural Assistants have been engaged under the District Agricultural Officer (Native), Moshi, in the constant supervision of the native coffee crop on Kilimanjaro.

3. The clerical staff consisted of a third grade Asiatic clerk, attached to the Circle office, and one African clerk with the Entomologist.

4. The African Instructor staff through reasons of economy was reduced by ten in the early part of the year, the numbers being as follows :—

	1930	1931
Tanga, Handeni and Pangani Districts ...	14	8
Lushoto, Korogwe and Pare Districts ...	15	10
Moshi District	14	16
Arusha District...	4	3
Total ...	47	37

5. The above organization of staff shows concentration where the agricultural possibilities obviously call for this, while areas of poor agricultural potentiality may be ignored provided the food supplies are sufficient for the population. This policy is a direct one of obtaining value for money spent, that is of carrying out work which will result in a substantial contribution to the wealth and resources of the Territory, with additional protection as can be given to such a vulnerable industry as coffee, and for the general provision of ample food supplies for the native population. In the same way the District Agricultural Officer concentrates on those areas where crops of economic importance can best be produced, or where the character of the native himself is such that there is an appreciable reaction to their propaganda and advice, resulting in outstanding areas where improved methods are in use for the growing of superior varieties of crops, which, especially where combined with the sound native practice learnt by the dire experience of many generations, gradually extend to the surrounding and possibly more backward tribes.

6. With Estate Agriculture, it is the aim that each and every estate be visited, that not only may we obtain an appreciation of every difficulty and problem that may beset the planter, but also to enable the department to be the liaison between planters for the dissemination of knowledge of good farming practice proved by local experience. Also with certain estates, possibly showing some peculiar problem, a closer touch is kept for more detailed observation in the hope that ameliorative measures may be evolved for general application.

7. In view of the close proximity of Taveta (Kenya) to Moshi, arrangements have been made with the Director of Agriculture, Nairobi, for this department to assist and advise the planters of that area.

Touring and Correspondence.

8. 22,083 miles were travelled by motor car; 366 miles were travelled on foot from camp to camp; and 1,178 nights were spent away from the station on duty.

The number of inward items of correspondence dealt with was 6,236 and the number despatched was 6,310.

General.

9. Mr. E. Harrison, the Director of Agriculture, made tours of inspection of the Circle in February, June and September. The policy of decentralization carried out by head office has proved most successful and has facilitated the work of the Agricultural Officers in the Northern and Tanga Provinces.

10. The closest contact and co-operation has been maintained with the East African Agricultural Research Station, Amani, and it is desired to express appreciation of the help and advice given to the officers of this Circle by the Director and his staff. Visits have been made to Amani by practically every officer, while Mr. W. Nowell, the Director of the Research Station; Dr. Storey, the Mycologist; Mr. G. H. Milne, the Soil Chemist; Mr. L. R. Doughty, the Geneticist; and Mr. T. W. Kirkpatrick, the Entomologist, have toured the coffee planting areas in conjunction with officers of this department. As an outcome of these visits a meeting of the Amani staff and agricultural officers of this Circle is being arranged for discussion of the problems encountered by the field officer.

11. Following a visit of Messrs. Sturdy and Sanders to Nairobi, Mr. de la Poer Trench, Senior Coffee Officer, and Mr. MacDonald, Mycologist, Kenya, visited the coffee growing areas of the Northern Province in September. Mr. R. H. le Pelly, Entomologist, Kenya, also visited Kilimanjaro in the early part of the year. This interchange of visits and close co-operation with the Kenya Department of Agriculture has been of mutual benefit.

12. Mr. F. A. Stockdale, Agricultural Adviser to the Secretary of State for the Colonies; Sir Arthur Hill, the Director of the Royal Botanic Gardens; Mr. Alexander Holm, the Director of Agriculture for Kenya; Dr. Tothill, the Director of Agriculture for Uganda; and Captain Smee, the Entomologist of Nyasaland, made a short tour of the coffee growing areas of Kilimanjaro, when on their way to the conference which was held in February at the East African Agricultural Research Station, Amani.

13. The Senior Agricultural Officer and the Entomologist attended, as members, the first meeting of the Coffee Advisory Board which was held under the Chairmanship of the Director of Agriculture at Moshi on 11th February, and the former attended the second meeting of the Board on 3rd October. The Senior Agricultural Officer was also a member of the Marketing Organization Committee which sat at Arusha in March.

14. Cordial relations have existed between the planting community and the department, and we are especially indebted to the planters' associations for the co-operation and help that they have extended to us. These organizations have facilitated our work in every way. They are capable of offering a close liaison between planters and Government such as is worthy of the support of every planter.

Weather and Rainfall.

15. In the Western Usambaras, Moshi and Arusha Districts, the total rainfalls of the year were all from fifteen to twenty per cent. above the average; but the distribution was poor, most of the precipitation fell over a comparatively short period in April and May: at Moshi township out of a total rainfall of 52·77 inches, 12·77 inches fell in six weeks of this period of which eleven inches fell in the space of ten hours only. The short rains were delayed until December when the precipitation was again heavy but concentrated over a period of not more than a week; while in Lushoto the short rains failed. The intervening period was unusually dry.

16. In the coastal areas the long rains were also abnormally heavy but were more prolonged than elsewhere; the short rains were poor and practically failed in the Handeni District. The "mango" rains which fall in July or August on the coastal belt alone, were heavier than usual, and conditions for plant growth were excellent for almost throughout the year. Native foodstuffs as a result were abundant.

17. The failure of the short-rains has the most serious effect on native agriculture, depriving the native of food which he has optimistically anticipated at a time when the harvests of the long rains are consumed and food often badly needed. In areas where the native grain crops are entirely dependent on the rainfall, and food shortages have occurred, the policy should be to anticipate drought and famine by urging the native to grow a drought-resistent crop such as cassava, a plot of which near to his hut remains a constant store of food supply which can be drawn upon at any time. It is useless to increase the area of such drought-susceptible crops as maize and rice, for whatever the area sown above the normal requirement, if there is a drought these crops will suffer, and if the rainfall is normal the local market is glutted with grain at the expense of the economic cash crops which normally maintain a healthy flow of trade through the district.

18. In noting the effect of the year's rainfall on coffee it is important to remember that the short rains of 1929 were unduly heavy and were carried through almost continuously to the long rains of 1930. Such a continued precipitation was most favourable for the setting of the coffee blossom, but most unfavourable for the necessary aeration of the soil, so that in the 1930 season it became impossible for the plant to feed sufficiently the great amount of cherry which it bore; there were comparatively long periods when

denitrification must have occurred, the consequent lack of available nitrogen causing the chlorosis or yellowing of the leaves of the coffee plant, and "die-back" later became rife.

19. The rains of the period November 1930 to June 1931, the critical period for coffee, were good for the 1931 crop, but as a result of the very heavy bearing experienced in 1930, the coffee trees had not recovered sufficiently to form flower bud; and yields were consequently poor; where overbearing and "die-back" had not occurred in the previous season, the rains were ample to bring out the flower and to ripen the crop.

20. Each succeeding long-rains brings home more and more painfully the undeniable fact that on the mountain slopes of the Usambaras, of Kilimanjaro and of Meru, through erosion the native is losing his heritage and the planter his capital as measured by the fertility of the soil. It has taken thousands of years to build up these soils; under the present conditions their actual and potential wealth will be washed away within half a century, for the protective forest growth has been cut out and the land further exposed to severe erosion through its surface being loosened by the processes of cultivation. No terraces are provided; storm and contour drains until recently were absent; only in a few instances have cover-crops been employed. The all too common practice of clean-weeding makes the matter far worse.

21. The planter, as can be understood, is anxious to obtain a quick return for his money, to do this he may spend an appreciable sum on artificial manure, and most of this added fertility is again washed out. It is felt that once the planters generally appreciate the position they will take precautions to conserve the fertility of the soil, on which their livelihood and the prosperity of the Territory depends. It is not a spectacular process: very little sound farming practice is. The native also must be made to realize the danger; the Wachagga are especially jealous of their lands, they should be equally jealous of the soil-fertility of those lands which will be lost to them by erosion as surely as they could be by alienation, unless they adopt a system of *intensive gardening*, which on the steeper slopes of Kilimanjaro should be carried out on terraces. In Handeni the Native Authorities have forbidden the cultivation of the steep-slopes immediately adjoining water courses, and similar action has been agreed to by the Native Authorities of Kilimanjaro.

22. Hitherto, it has been difficult to turn the train of thought of planters from plant pests and diseases and pruning to a consideration of the plant in relation to environment, but some progress has been made and there are several planters who followed advice and put in storm-drains, contour-trenches, stone-bunds, contour-hedges, pits and terraces, to prevent soil-wash. The subject of soil-erosion has received serious consideration in Ceylon, a country with a much longer and more varied experience of agriculture than Tanganyika; an extract from the report of the Committee on Soil Erosion reads "that, after educative methods have been tried for seven years, the subject should be brought up for review on the understanding that, if conditions are still unsatisfactory, compulsion by means of legislation should be further considered." Unless the cultivators of Kilimanjaro, Meru and the Usambaras, adopt the measures so continuously advocated by this department, something of the sort will be required here, or the soil of many estates will

be incapable of economic production within a comparatively short period. In Ceylon the failure of Arabica coffee about 1880 was ascribed to a severe attack of Hemileia, it is now held to be largely due to soil impoverishment caused by soil wash until finally the coffee endeavoured to exist on the subsoil alone. The loss of plant food by erosion in the United States of America is estimated at twenty-one times that taken up by heavy cropping, and in Ceylon it is stated that erosion to the extent of 0·17 inches equal to a loss of 115 tons of surface soil per acre occurs on moderately sloping land.

23. Demonstration plots of terracing, contour trenching, etc., have been laid out at Muhesa, Lushoto and on seventy-seven plots on Kilimanjaro. Such measures to prevent erosion must, however be regarded as a secondary yet necessary line of defence. The first essential is a ground-cover: the use of cover-crops and green manures has been a rapidly extending practice in Java and Sumatra especially and latterly in Ceylon. About thirty indigenous plants regarded as suitable for cover-crops, contour-hedges and green-manures have been collected and are being tried at various elevations on Kilimanjaro at Lushoto and Muhesa, in addition to trials of several introduced plants. The functions of cover-crops and green-manures can be briefly described as follows:—

(i) the prevention of soil wash;
(ii) the reduction of weeding costs and eradication of plants harmful to the standing crops;
(iii) the protection of the surface soil from the excessive heat of the sun, and hence protection of the surface plant-food absorbing rootlets of such crops as coffee;
(iv) the addition of humus to the soil, and consequent greater moisture retaining capacity of the soil and improved tilth;
(v) the aeration of the soil by penetration of the roots;
(vi) the fixation of nitrogen from the air where leguminous plants are used;
(vii) the retention of available plant food taken up and returned to the soil by the cover-crop or green-manure, which otherwise would be washed away.

24. The subject of maintaining the fertility of Kilimanjaro cannot be dismissed without reference to the "soiling system" of feeding cattle, that is by growing rotations of green crops as lucerne, maize, pea and oats, cabbages, etc., to be cut and fed green to the cattle which are kept indoors the whole time, except for one or two hours for daily exercise in an open enclosure. The manure being returned to the soil each day, and after the second or third cutting of such leguminous crops as lucerne, these are dug in for an additional improvement of the soil. This is an intensive system of dairying, for which the Northern Province will be well suited as soon as east coast fever can be controlled. It is followed by the native at the present day, but instead of growing their cattle food their women-folk laboriously cut and carry over a distance of several miles grass from the plains. Edible canna is capable of giving high yields of green leaves and succulent roots during the dry season, and this crop has been introduced as a stock feed into native agriculture in the hope that its extended use will save the present waste of labour in grass-cutting and carrying.

General Remarks on Crop Production.

25. Broadly speaking, estates in the Northern and Tanga Provinces are concerned with one economic crop for export, either sisal or coffee; they may grow subsidiary crops such as maize for their own or other labour, or such products that will supply the local market, but in the main their source of income is represented by one crop. Thus any great fall in world prices of this product, brings the individual perilously near the line where he cannot carry on, as also with one crop production in other lands such as maize in South Africa, cotton in America, and wool in Australia. When those main products such as sisal and coffee, and especially sisal, form the greater part of the visible wealth of the Territory by a fall in price, all sections of the community are seriously affected, and all must bear their share of the burden, even to those financial interests that so widely control the productive efforts of the planters.

26. There are two alternatives, either that of cutting losses and abandoning production, or of carrying on. The first is a gospel of despair which would play into the hands of the foreign competitor and mean lost markets difficult to regain, while plantations would quickly revert to bush. But the planters with the backing of those financial houses having the courage of their convictions, are taking a different view and are continuing production with but comparatively few exceptions. The sisal growers especially call for admiration in this respect.

27. The policy of fighting the present depression calls for a general reorganization, and will have its advantages finally in better farming, in careful costings and business management, and in cutting out all those weaknesses which have been apparent in production, marketing and distribution. This can be seen on every hand; individuals are out for production of quality, and the cutting of their costs is extended deep into their home-lives. Planters' associations are reorganizing for more effective co-operation between individuals, other similar bodies, and with Government. The latter has formed a Coffee Advisory Board, and appointed a committee which enquired into marketing organization as affects this Territory. But the planter must still meet the same mortgage charges and marketing costs.

28. As regards native production, the native has a low standard of living, he has no capital charges and rarely any labour costs and thus should be less affected by the world depression. This is not so, however, his nature will not allow it, for in addition to being lethargic he is easily dispirited; he remembers only the good times, and on every occasion that a low price is obtained for his product he cuts down or ceases production in the following year, in the same way that if he suffers from famine in one year he will increase his area of food crops for the succeeding year, but not the next. He thus becomes incapable of carrying out the lowest functions and obligations that should be expected of a citizen of any state; his buying capacity is so lowered, especially in areas of annual cash crops, that a general stagnation of trade results, adding further to the general depression. The remedy here lies in greater production, it can be done many times over without exacting more than two or three hours of work per day over about one-third of the year only; an intensive organization and propaganda for increased production has been followed for the 1932 season. It is not sufficient, however, to arouse the

interest of the native, it must be maintained, and one obvious means is the co-operative society, which is becoming more and more common throughout the world.

29. Thus greater quality is desired for non-native produce and greater quantity the immediate need with native production, we should endeavour to support ourselves wherever possible and so increase internal trade. In 1930, over £60,000 worth of raw products and foodstuffs were imported into the Northern and Tanga Provinces alone, the greater part of which could have been produced within the Territory. The attention of Chambers of Commerce, Planters' Associations, importers and consumers has been drawn to this and an encouraging response has been made to support the local grower.

Crops and Cultivation in Detail.

30. *Sisal.*—The following are the amounts of sisal fibre exported during the past three years :—

Province	1929 Tons	1930 Tons	1931 Tons
Tanga	34,542	36,480	38,113
Northern ...	1,560	1,659	1,718
Total ...	36,102	38,139	39,831

31. The above amounts were shipped through the ports of Tanga and Kilindini as follows :—

Port	1929 Tons	1930 Tons	1931 Tons
Tanga	35,313	37,728	39,552
Kilindini ...	789	411	279
Total ...	36,102	38,139	39,831

32. The manner in which estates have generally maintained production in face of, or possibly because of low prices, is seen in the above record figures of the amounts of sisal exported in 1931 ; but the value of the total exports for 1931 was less than half that for the year 1929.

33. The price of first grade sisal fibre was £17 per ton in January, there was a fairly continuous fall to £12 per ton in September, with a sudden rise to £17 10s. followed the abandonment of the Gold Standard by the Home Government.

34. The cultural side of sisal production suffered severely from the fall in prices and general world-wide depression ; the larger concerns have, however, taken a more prudent course of restricting output and conserving existing plantings. In addition they have evinced their confidence in the industry by replanting old areas and installing improved machinery. A plant for the artificial drying of fibre has been in operation throughout the year on one estate, and has been so successful that other estates will follow suit as soon as the economic conditions show signs of improvement. A few concerns closed down during the year and one company was forced into liquidation.

35. The need of greater co-operation between East African sisal interest has been realized by the Tanganyika growers, and the previous local sisal associations over the Territory are now combined to form the Tanganyika Sisal

Growers' Association, with head-quarters at Tanga. A good deal of work has already been carried out by the new association on all matters pertaining to sisal production, distribution and marketing, as reported in both the local and the home press. The solution of the problems besetting the sisal industry is a matter of world co-operation, it is beyond purely local control.

36. Brokers have referred from time to time to the indiscriminate and weak selling for parcels of East African sisal, which is due, however, to the fact that many producers are indebted to banks and merchant-houses, and are forced to sell their produce as early as possible, often without regard to the state of the market. This further depresses the level of prices and reacts on those producers who are unembarrassed financially, but are obliged to sell at the same unprofitable rates. Thus it would appear to be economically unsound for a firm to be both creditor and broker, for in such times of financial stringency as the present, the former interest comes first.

37. The use of cover-crops to cut down weeding costs has been advocated, and several species are being tried in sisal in the Tanga District. An indigenous Crotalaria, identified by the Botanist at Amani as *Crotalaria invantulensis* Welw. Ex. Baker. forma, was discovered near Moshi both in the bush and in sisal which had formed itself into a single community ousting all grass and weed-growth. It is strongly nitrogen-fixing and sisal surrounded by this plant was stronger and healthier than under other conditions. Sisal growers who were shown the areas under this Crotalaria were immediately enthusiastic and many demands for seed have been made. Trials of this cover crop are being made in the coastal belt, which if successful will change and considerably cheapen the methods of sisal production.

38. *Coffee.*—The production of coffee in the Northern and Tanga Provinces is practically all of the Arabica type, with small amounts of Robusta in the high rainfall areas of the Eastern Usambaras where the conditions have proved unsuitable to Arabica coffee, and in the Nguu Hills of the Handeni District. The Robusta coffee is all sold for local consumption.

39. The following are the amounts exported over the past three years from the various areas :—

District	1929 Tons	1930 Tons	1931 Tons
Arusha	785	1,418	838
Moshi	1,113	2,674	1,636
Usambaras ...	144	207	188
Total ...	2,042	4,299	2,662

40. The above amounts were shipped through the ports of Tanga and Kilindini as follows :—

Port	1929 Tons	1930 Tons	1931 Tons
Tanga	1,499	2,498	1,265
Kilindini ...	543	1,801	1,397
Total ...	2,042	4 299	2,662

41. The amounts of (A) estate (non-native) and (B) native coffee produced for export over the past three years are as follows :—

District	1929 Tons		1930 Tons		1931 Tons	
	A	B	A	B	A	B
Arusha	754	31	1,373	45	805	33
Moshi	573	540	1,918	756	1,073	563
Usambaras ...	144	—	207	—	188	—
Total ...	1,471	571	3,498	801	2,066	596
Grand Total ...	2,042		4,299		2,662	

42. *Estate Coffee.*—As with sisal the greatest problem of the coffee planter at the present day is first and foremost one of economics, which subdues the purely agricultural aspect in some cases to such a point where adequate cultivation and protection against pests is rendered difficult. Planters have frankly discussed the position at the meetings of their associations and especially at a conference of the coffee growers of the Northern Territory held at Moshi in February, 1931, where in view of the fact that the great majority of the coffee planters are heavily committed financially, considerable apprehension was expressed of the general financial position of the industry, which must be regarded as most serious to the planter and financing-houses alike.

43. Again as with sisal it is a matter of the merchant-houses combining the functions of both the financier and selling agent. Financial commitments were too easily incurred during the boom period with its attendant inflation of land values, and whereas the latter have fallen together with world prices the planter must still endeavour to meet the same interest charges on a greatly reduced earning capacity of his estate, which may absorb from 45 to 75 per cent. of the net return.

44. The question of marketing has received the close attention of the various planters' associations and of the Coffee Advisory Board. It absorbs what is considered to be an undue proportion of the gross receipts, and the importance of placing a high quality product on the market will be seen from the following figures of the costs of marketing coffee, obtained from the account sales of a parcel of 96 bags of parchment coffee, weighing six tons gross, the net sale-weight of clean coffee being 91 cwts. 3 qrs. 1 lb., tare being taken at 3 lbs. per bag, the loss in cleaning being 20·9 per cent. while the trade draft accounted for 0·87 per cent. of the net weight of parchment. The figures are given as percentages of the gross proceeds realized from the sale which amounted to Shs. 70/50 per cwt. of cleaned coffee :—

Insurance	0.835 per cent.
Freight [less 10 per cent. rebate] ...	7.100
Cleaning and wharf charges... ...	7.090
Sundries including sale expenses ...	0.350
Discount to buyers	1.000
Brokerage	1.000
Commission	2.475
Rail and Shipping charges	4.450
	24.300 per cent.

The following table shows the varying percentages of the gross receipts absorbed in marketing different qualities :—

Average gross price per cwt. of cleaned coffee	Freight and London charges	Rail and Shipping charges	Total
Shs.	Per Cent.	Per Cent.	Per Cent.
40/- ...	30.91	2.84	38.75
50/- ...	25.78	6.27	32.05
60/- ...	22.37	5.23	27.60
70/- ...	19.93	4.48	24.41
80/- ...	18.10	3.92	22.02
90/- ...	16.68	3.40	20.08

45. It is obvious that the lower grades could best be disposed of locally or to the nearest eastern markets. This is rendered possible by the presence of coffee cleaning and curing works at Mombasa and Nairobi (the Department of Agriculture for Kenya now allows the movement under license of coffee from the Northern Province to Nairobi). Several firms have expressed a desire to erect a coffee cleaning factory at Moshi, the matter has been discussed by the Coffee Advisory Board and is under consideration by Government.

46. The 1931 season was a very poor one as far as yield was concerned; of the above exports of coffee about one-third represents a carry-over from the 1930 season, the carry-over from 1931 for export in 1932 will be comparatively small. Low prices were realized in London at the beginning of the season, the average price for A's being about £60 per ton, but with the abandonment of the Gold Standard, combined with a scarcity of mild coffees the average price increased to £90, while £131 was realized for one Kilimanjaro consignment and £152 was the record price for Arusha (Tengeru) coffee.

47. *Native Coffee.*—The areas where native coffee is grown are :—

(i) Kilimanjaro, where there are nearly 13,000 native growers of Arabica coffee, owning about six million trees of which some three and a half million are in bearing. These growers are all members of the Kilimanjaro Native Planters' Association.

(ii) Arusha, where on the slopes of Meru there are about 700 native Arabica coffee growers who also have an association which, however, is one merely in name.

(iii) In the Pare Hills 356 natives, against the advice of this department, planted Arabica coffee some few years ago but the conditions proved entirely unsuitable and many are now uprooting their coffee and returning to cotton planting in the plains. The growers are nominally affiliated to the Kilimanjaro Native Planters' Association.

(iv) In the Western Usambaras, the number of native growers of Arabica coffee has increased from 200 in 1929 to nearly 500 in 1930.

(v) In the Eastern Usambaras of high rainfall, there are 94 native planters of Robusta coffee, while there is a small number of such growers in the Nguu Hills of the Handeni District.

(vi) In Mbulu District there are 31 native growers of Arabica coffee whose plots are all considerably larger than the average found on Meru or Kilimanjaro.

48. The close attention given to native coffee is seen in the following table of inspections carried out over the past two years by the District Agricultural Officers, and their Agricultural Assistants. Wherever possible the closest co-operation is maintained with Native Authorities and the Native Planters' Associations in this work :—

	Arusha		Moshi	
	1930	1931	1930	1931
Number of grower	708 ...	700 ...	12,500 ...	12,500
,, ,, inspection	1,217 ...	744 ...	14,798 ...	21,847
Written orders given	71 ...	141 ...	566 ...	1,688
Prosecutions	11 ...	32 ...	77 ...	60
Plots uprooted	1 ...	— ...	4 ...	7

49. In addition to the 1931 season being a poor one as regards yield, it has been an unfortunate one as regards the marketing of the crop. The District Agricultural Officer in charge of native agriculture on Kilimanjaro reports: "The greater part of the 1931-32 crop is being purchased outright by licensed buyers in competition with the Kilimanjaro Native Planters' Association. The buyers now number twenty-one and competition is so strong that the marketing of the crop has developed into an undignified scramble, with scouts of the various buyers patrolling streets and cross roads in and around Moshi to waylay growers. Conditions such as these are conducive to irregularities. Indiscriminate buying without reference to quality is direct encouragement to careless preparation and, later, adulteration. Slackness at any stage leads to slackness elsewhere: careless preparation is followed by neglect of cultivation, and finally the spread of pests. Consignments have been examined this season which were definitely musty, with beans covered with saphrophytic growth. One large consignment (from the principal Moshi buyer) arrived at Kilindini too wet to clean, and the following consignment had to be unbagged and dried at Moshi before despatch. Lack of control over the marketing of the crop will undo the educational work of years. Not only the good name of native coffee, but of Kilimanjaro coffee generally is concerned, since it is known that some consignments of native coffee have been sent home as plantation produce. The native coffee industry had the advantage that for the first few years of its growth the grading and marketing of the crop was in the hands of the Agricultural Department, and it is interesting to note that at the early sales of the 1927-28 season Kilimanjaro Native Planters' Associations' coffee sold at the highest figure (£129) in competition with plantation coffee. There is real danger that this initial advantage will now be thrown away. With the example of the Bukoba industry the present trend of affairs is deserving of strong comment."

Departmentally we have been completely impotent to effect an improvement in this matter, which has greatly handicapped our work to effect improvements in both the culture and preparation of native coffee.

50. Despite the poor preparation which was outstanding in the past season, some consignments have been surprisingly good, one gave 75 per cent. A's, which would be considered high for estate coffee, three

consecutive consignments realized £99, £94 and £100 for A, £73, £65 and £79 for B and £40 and £60 for C respectively. The price paid by the local buyer was 27 cents per pound or 60 cents per kilogram for the first quality parchment, an arbitrary deduction being made for lower qualities. In December 75 cents per kilogram was paid.

51. The District Agricultural Officer (Native), and the prospective manager of the Kilimanjaro Native Planters' Association, with members of the Association and African Instructors visited the Kilindini Coffee Cleaning and Curing Works, where native and other coffee was seen in the various processes of cleaning, grading, etc., and defects and the causes thereof were pointed out. Following this and the propaganda continuously carried out by this department an increasing number of growers are asking that the crop be marketed separately by ridges in order that the advantages of better production and preparation be secured to progressive sections of growers. The establishment of collecting stations on the various ridges and their possible development into central pulperies has been examined; both will be inevitable finally.

52. It must be noted that the Kilimanjaro Native Planters' Association has been of little or no use to the department in the work for cultural improvement, neither have they been satisfactorily equipped with sprayer pumps and chemicals to deal with coffee pests and diseases. But as a result of our representations a first order has been placed for fifty pumps of the new design approved by the Entomologist to allow of triple-strength spraying for Antestia control, and fifty bucket-pumps for thrips. The association is being reorganized, and with the additional powers which will accrue to it under the new Co-operative Societies Ordinance it is anticipated that satisfactory services will be given by the association for cultural improvement, adequate pest control, and a sane system of marketing.

53. Natives co-operated in the intensive large scale control-measures instituted in the "block-sprayings" for Antestia. An intensive campaign was also followed for borer (Anthores), when with 769 plots in the borer belt over 43,000 borer-grubs were destroyed and 17,985 coffee trees were uprooted or stumped, and burned, because of heavy borer infestation. A thorough clean up was effected. The manner in which the native grower has accepted the measures taken for pest control, indicates the extent of his appreciation of the danger from pests and diseases.

54. *Factors in Coffee Culture.*—The effect of rainfall on the coffee crop has been noted in paragraphs 18 and 19 above. Careful observations in the field have been made on coffee trees under varying conditions, while investigations and experimental work in other countries both on coffee and all other crops and especially other fruit trees has been followed and carefully examined in order to determine any analogies which may exist with coffee. Mr. F. R. Sander's work in this respect deserves especial mention. The absence of an experimental station has been a great handicap, for without the opportunity for detailed anatomical and physiological study little definite progress can be made; nevertheless we feel that we have advanced to a position where seemingly correct analogies can be put forward to explain some of the problems of coffee-culture in the Northern Province and possibly elsewhere, on which hitherto there has been a discreet silence. A pamphlet on these matters is

being prepared, not because it is considered that we have reached infallible conclusions, an experimental station is necessary to provide indisputable data, but in the hope that it will lead planters and others on to new lines of thought, trial or investigation. Here the various problems are briefly described below.

55. In the past two or three seasons more has been heard of overbearing and "die-back" with coffee in the Northern Province than ever before. Work carried out by the Mysore Department of Agriculture shows that a heavy crop of 1,200 lbs. of clean coffee per acre removes from the soil 27 lbs. of nitrogen, 5 lbs. of phosphoric acid and 24 lbs. of potash, further but 60 per cent. of the available nitrogen, 10 per cent. of the soluble phosphoric acid and 50 per cent. of the potash applied is absorbed by the crop. In temperate climates, manures act best when the ratio of nitrogen to phosphoric acid is 1 : 3, but 2 : 3 is considered best for the tropics. Hence the manurial requirements of a 1,200-pound crop will be :—

Nitrogen	... ...	50 lbs.
Phosphoric Acid	...	75 ,,
Potash	... ...	100 ,,

56. On the majority of estates much more plant food has been lost by soil erosion than is taken up by the crop, and if the planter will reflect and calculate what has been taken out of his soil and what he has put back, he cannot wonder that his trees are easily affected by cropping alone, and rendered very susceptible to pests and diseases. It can be stated, that generally speaking, soil impoverishment is the direct cause of many evils of coffee growing ; the alternate-year-bearing so commonly seen is not inherent in the coffee-tree but is largely due to the nutritive capacity of the soil. It must not be considered that the extravagant application of artificials alone will restore fertility, this is at any rate a costly proceeding, the humus content of the soil must first be increased, and this can be done most economically by green-manuring : the sure foundation of plantation farming in the tropics. The yield of green manures is increased by an application of phosphates to the cover-crops.

57. Carbohydrates are assimilated by the plant leaves during hours of sunlight, while nitrates are absorbed by the delicate fibrous roots occurring with coffee near the soil surface. If the formation of carbohydrates is abnormally excessive over nitrate absorption, then conditions are favourable for the setting and growth of additional fruit. It is an examination of this carbohydrate : nitrogen (C : N) ratio in conjunction with environment that has shed a good deal of light in our minds at least on the peculiar behaviour of coffee in the Northern Province. Generally speaking in the temperate regions, the hours of sunlight, and of soil biological conditions tend to produce a narrow C : N ratio, hence fruit growers are concerned with promoting the formation of fruit : by root-pruning to cut down the supply of nitrates, by girdling of the stem to restrict the passage of inorganic salts from the roots up the outer cortical layers of the trunk and so concentrating carbohydrates in the top of the tree for fruit formation, also by allowing grass to grow in orchards which chokes the formation of the fibrous rootlets and so decreasing nitrate absorption.

58. In the tropics the long hours of sunlight produces excessive carbon-assimilation, and so there is a wide C : N ratio tending to overproduction of fruit. Shade restricts carbon-assimilation and so tends to prevent over-bearing; but shade in itself is not sufficient, and may be overdone especially as excessive shade of the non-leguminous type may take too much out of the soil, and may harbour pests such as antestia. The main problem in tropical farming is to maintain a high humus content in the soil and a good supply of nitrates, if these are artificially restricted then the C : N ratio is further increased and overbearing and consequently "die-back" with coffee results.

59. Nitrate supply and absorption are widely restricted as follows in coffee estates in the Northern Province :—

(i) Soil impoverishment through erosion and neglect of green-manuring.

(ii) Disturbance of the fibrous plant-absorbing rootlets. Observations have been made and it has been ascertained that there are definite periods when these rootlets, so vital to the plant, grow and when they rest. Cultivation during the growing period may prevent nitrate absorption at a most critical time.

(iii) The rootlets must have air and a good soil-tilth for proper development; either this is not given through fear of cutting the roots near the tree, or cultivation is carried out with considerable root-disturbance. The use of a vertical fork driven into a depth of nine to twelve inches and merely gently shaken, *not turned*, is sufficient. Too deep planting is responsible for sickly coffee on some estates.

(iv) Saucer or "Sahani" irrigation is too commonly practised, and the formation of saucers round the trees often results in great damage to the lateral roots as well as to the fibrous rootlets. The alternate waterlogging and parching of the bare soil in the saucers is inimical to plant-growth, although the supply of water may result in a temporary visible improvement in the foliage. This type of irrigation is truly a "vicious circle". Where irrigation is necessary it should be done by frequent small soakage pits in between the rows, but constant green-manuring should obviate the necessity of irrigation.

(v) The waters of Meru and from the Rift-wall contain abnormally high quantities of sodium salts, especially sodium carbonate ("black alkali"), and the Soil Chemist, Amani, reports that the irrigation waters of Meru, Arusha District, "require special care to prevent gradual alkali accumulation." Saucer irrigation tends to concentrate alkali round the root-system to the extent that the fibrous rootlets are killed. A furrow leading between the rows from pit to pit is best, such a system also promotes drainage in the rains and the alkali becomes washed away from near the root-systems. Green-manuring, applications of sulphate of ammonia, superphosphate and gypsum are advocated and are under trial as ameliorative measures.

(vi) Excessive soil temperatures are harmful; where the soil is bare and exposed to sun the temperature of the surface becomes so high that the rootlets are shrivelled up. Grass-mulches keep the soil from 20° to 40°F. cooler than where the land is bare, and promotes extensive root development. A permanent cover-crop is also of great value in this respect.

(vii) Small planting-out pits restrict root growth; work at the Imperial Institute of Fruit Production at East Malling, shows that good sized pits with a heavy dressing of well-rotted farmyard manure in the bottom of the pits, result in a much more extensive root system than where manure is not applied in the pits. Such a practice could well double or treble the amount of inorganic plant foods in solution which could be taken up by the plant.

60. The common practice of pruning heavily three or four times each year, especially in a season of poor crop, is condemned by Mr. Sanders, who holds that one heavy pruning is necessary where "die-back" has occurred, but when the tree has thrown out good wood it is both unnecessary and costly to remove primaries or those branches acting as primaries and to continue the practice into the blossoming period. It appears that the idea is generally held, that heavy pruning gives a limitation of the bearing surface and concentrates plant-food in the bearing wood; but no selection is made of bearing wood for the following year. This cuts down leafage and the crop must be ripened on stored energy which too often is insufficient. It is better to leave as much leaf as possible and limit crop by stripping flower or young cherry back to the terminal mature node; there is then a sufficiency of food material to carry the fruit to a robust maturity.

61. To determine the correct time when pruning should be done in relation to flowering, information is required on :—

(i) the graph of carbohydrate accumulation during the annual cycles;
(ii) correlation of growth observation with the various carbohydrate cycles;
(iii) the relation of the cessation of short-growth to flower bud formation, and the correlation of cycles of shoot and root-growth.

The difficulties in carrying out experiments on estates to give such information are great, but they have been started and observations are being made on the periodicity of root and branch growth, leaf-fall, rate of formation of mature wood, time of occurrence of spike or vegetative bud, and time of flowering of primaries and secondaries.

62. In addition, experiments are in progress in co-operation with planters for manurial requirements, effect of organic and inorganic manures on the quality of coffee, treatment of alkali and artificial shade. An investigation of fermented and unfermented coffee is also being made, samples have been sent to several London brokers for report.

63. Yield and quality of coffee are mainly inherent factors, and in any plantation in the Northern Province there are a great variety of types of coffee plants many of which are uneconomical units of the plantation; the bulked coffee is also of a very mixed nature. The standardization of the coffee of an estate or groups of estates by vegetative reproduction from proved mother-trees of high yield and good quality has been considered, and grafting and budding experiments have been made. This, however, is a wholetime job for which at present we have no one to spare, and until an officer, trained in vegetative reproduction of plants, is available, but little headway can be made. It is considered, however, that such a work could increase the returns of existing plantations by a very considerable amount within a period of several years.

64. *Tea.*—In the high rainfall areas of the Usambaras, where Arabica coffee has not proved an unqualified success, and the price of Robusta coffee renders this crop unprofitable for plantation enterprise, tea has proved eminently suitable. One large estate has 840 acres of the crop and expects to pick up to 100,000 pounds in the 1932 season, the product has received favourable report in London, and with the keen competition given by Kenya tea and the proposed internal tax on tea, the producers hold it to be more profitable to sell abroad than locally. There are other small areas under this crop, and it is obvious that the industry could be considerably extended. Cover-cropping and cultivation with vertical forks have been taken up with enthusiasm.

65. *Cacao.*—Cacao of a very superior quality is grown at the Sigi Segoma Estate, Tanga. It is partly of the Criollo type and enquiries have been made by home firms as to the possibility of increasing production. There is room for extension in the valleys in the vicinity of Segoma at least.

66. *Maize.*—During the past decade maize has been imported into the Territory in very large amounts. The imports into the Northern Province in 1930, amounted to 1,202 tons of maize grain and 508 tons of maize flour, representing an efflux of money from the Territory when a greater circulation within its borders is so necessary. This matter has received prolonged consideration, and steps have been taken which it is hoped will prevent the importation of poor quality often unwholesome maize from adjoining territories. For the year 1931, it is encouraging to record that 1,693 tons of maize were exported from the Moshi District alone, while less than 10 tons were imported; 188 tons were exported from the Arusha District. The Western Usambaras is capable of a large native production of good quality maize, and a surplus of 432 tons was produced for consumption in the Tanga District, a figure practically twice that of any previous years; 12 tons of Potchefstroom Pearl maize seed was distributed in this area in 1931.

67. *Cotton.*—Cotton has not been an important cash crop to the Northern and Tanga Provinces in comparison with other products, but there are good possibilities for Handeni and the Pares, where under the intensive campaign instituted towards the end of the year, a production of 1,500 tons of seed-cotton is expected in 1932. The output of cotton-lint in 1931 by the ginneries of Mzundu and Kwangero in the Tanga Provinces and of Himu in the Northern Province is as follows :—

Province	1929 lbs.	1930 lbs.	1931 lbs.
Tanga	127,199	68,574	6,777
Northern	37,342	52,650	*13,615
Total ...	164,541	121,224	20,392

*Ginning only began towards the end of December and most of the 1931 crop of 90 tons of seed-cotton will be ginned in January, 1932.

68. The sales of seed-cotton by natives during the 1931 season were as follows :—

Area	1st Quality kgs.	2nd Quality kgs.	3rd Quality kgs.	Total kgs.	Value Shs.
Handeni	16,589	1,204	3,869	21,662	2,379
Pares	48,603	5,769	9,258	63,630	5,727
Moshi	11,988	1,177	2,211	15,376	1,670
Total ...	77,180	8,150	15,338	100,668	9,766

There was a great drop in production in Handeni from 104 tons of seed-cotton in 1930 to 21 tons in 1931, this was balanced somewhat by increases in the Pares and Moshi ; the total production in 1931 was 134 tons.

69. The prices paid were 10, 7 and 5 cents per kilogram for first, second and third qualities respectively in the Pares and Moshi areas, while 13, 9 and 6 cents were paid in Handeni. There was no competition in any area, minimum guaranteed prices were arranged by agreement with the ginners.

70. There was a non-native production of ten tons of seed-cotton in the Pares from cotton intersown with sisal and five tons in the Moshi District.

71. *Copra.*—This product is produced mostly by natives along the coastal belt of the Moa, Tanga and Pangani areas, there are also large Indian and Arab owned coconut plantations. The bulk of the copra is sent to Zanzibar, but some is used for soapmaking in Mombasa. Improvement in the sanitation of the plantations has been achieved under the Plant Pest and Disease (Coconut) Regulations during the year, but a great deal remains to be done with this and in the actual preparation of copra. The exports of copra show a large decrease due to poor prices, the amounts being as follows :—

1931	...	...	2,119 tons.
1930	...	...	5,580 ,,
1929	...	...	3,857 ,,

72. *Potatoes.*—The Western Usambaras is the best potato growing area ; but the market is limited to local requirements which previously have been met from Kenya, but increasing amounts of local potatoes are coming in to the market. 165 tons were railed to Tanga from the Usambaras during the year while but 13 tons were imported. The imports into Moshi were 8 tons only. Seed of Kerr's Pink and Great Scott varieties was imported from Scotland, from which seven tons of seed has been distributed to estates, and further seed-multiplication is being made. Growers should note that potatoes grown on irrigated land become badly attacked by eelworm.

73. *Onions.*—In 1930, 138 tons of onions to a value of over £1,000 were imported into Tanga, the figure was 118 tons for 1931. The Northern Province is capable of meeting all the requirements of Tanganyika, which are mostly now met from India and Egypt. The local varieties are equal in keeping and other qualities to the Indian grown, but a little inferior to Egyptian, seed of which has been obtained for multiplication. Bermudan seed is also being obtained. 158 tons of onions were exported from Moshi via the Kenya-Uganda Railway in 1931, the export period being from August to March, while three tons only were imported during April to July. Twenty tons were railed to Tanga.

74. *Kapok.*—The greatest production of kapok occurs in the Eastern Usambaras, where new plantings have been made. The exports amounted to 67 tons for the year 1931, compared to 38 tons in 1930 and 85 tons in 1929. The fibre is really a cylindrical air-container, and a grower has proved that too great a density of the bale for export results in a rupture of this minute air-container and the kapok then loses its value.

75. *Cinchona.*—The three species of Cinchona: *Succirubra*, *officinalis* and *Ledgeriana*, are grown successfully in the Usambaras. One estate yearly exports six tons of bark to London, which bark commands satisfactory prices.

76. *Spices, etc.*—Vanilla, cinnamon and nutmegs all grow satisfactorily in the Eastern Usambaras. The production of spices could be widely extended to meet at least some of the spices imported annually to the extent of over £10,000. Pepper is grown successfully on a few estates, and is sold locally, there being a good native demand for it during the month of Ramadhan. Cardamons grow wild in the Usambaras, and seed of the Mysore type has been imported but no germination has resulted; rhizomes are now being obtained from India.

77. *Essential Oils.*—(i) A sample of "Petit-grain" oil distilled in the Tanga District from leaves of the Seville-orange tree was sent to the Imperial Institute and received most favourable report being valued at Shs. 8/75 per pound in comparison to Shs. 6/50 for the oil from the main producing country of Paraguay; ecquellor-oil can be obtained from the fruit by hand. It is a possible side-line to some sisal estates, one of which with 70,000 bearing trees is considering the production of both oils on a large scale.

(ii) Peppermint oil from plants supplied by the Imperial Institute through this department is being produced on a small scale in Arusha. The quality of the oil so far has not been good.

(iii) Two planters have displayed considerable interest in the production of essential oils and the following plants have been obtained from the Royal Botanic Gardens for trial, multiplication and distribution: *Peppermints*, *Rosmarinus Pyramidalis*, *Melaleuca leucadendron*, *Pelargonium radula-roseum* and *Pogostemon patchouli*.

78. *Tung Oil.*—No good or even encouraging results have been obtained yet with Tung oil.

79. *Fruit.*—(i) Stone fruits, apples and strawberries do well in the Western Usambaras, excellent grapes are also produced in the Arusha District. All fruits are sold locally, the supply is not equal to the demand.

(ii) In Handeni a new factory is engaged in the production of dried or "fig" bananas; the product is excellent but should be packed in sealed tins for export.

(iii) Round Muhesa in the Tanga District there is a considerable native citrus industry which is capable of improvement and wide extension. A citrus demonstration plot exists at Muhesa where ten imported varieties of oranges, naartje, grape-fruit and lemons are grown on terraces. Stocks of rough lemon are budded for distribution and it will soon be possible to supply budding-material for natives and others as required.

80. *Experimental Stations.*—The proposals for a coffee experimental station for the Northern Province, which it is the intention to open up with the aid of the Colonial Development Loan, still await the approval of the controllers of the loan. An excellent site has been provisionally selected and a comprehensive scheme of investigation and experimentation has been prepared, so that once the money is available a start may be made without delay. Meantime field officers are carrying out investigations under obvious difficulties which, however, can never be carried to a logical conclusion without the aid of an experimental station.

81. The matter of an experimental station for sisal was discussed with the Tanganyika Sisal Growers' Association and a representative of the Kenya growers by the Director of Agriculture, the Director of the East African Agricultural Research Station and the Acting Director of Agriculture for Kenya. A satisfactory site was provisionally selected.

82. As regards agricultural sub-stations maintained by the Native Authorities, in accordance with the policy followed generally by the department for the attainment of substantial and visible results with as little expenditure as possible by Government or Native Treasuries, seven sub-stations in the Handeni area were reduced to one central seed-farm which is capable of wide extension. At Pangani one sub-station is maintained, while in the Usambaras, the work of three sub-stations is being concentrated into one seed-farm of twenty acres at Lushoto, which will provide a large scale demonstration of all anti-erosion methods of coffee culture on terraces, and will allow of more intensive investigation regarding the vegetative reproduction of coffee. Additional land is being included. In the Pares one sub-station is being maintained, while on Kilimanjaro the funds allocated for agricultural work by the Native Authorities are being utilized for carrying out the demonstrations on anti-erosion methods so urgently required.

83. *Pests and Diseases.*—The coffee industry in the Northern Territory has been fortunate in having Mr. A. H. Ritchie, Entomologist, stationed at Moshi. Details of his investigations and the progress made will be found under his annual report for the year 1931. Large scale measures for the control of pests have been instituted under the name of "block-spraying", that is, days are appointed when both native and non-native coffee planters in a selected area spray for a particular pest, almost all coffee planters have reacted enthusiastically to the scheme which will go far to control the major pests and improve the quality of the coffee exported.

84. Previously the need of strict enforcement of the Plant Pest and Disease (Coffee) Regulations was not necessary, funds being readily available for estate upkeep in years previous to the slump, though they may have been badly and extravagantly used; in the 1930 season the coffee crop was large and on this advances were obtainable. But with the 1931 season of poor crop, some coffee estates were being completely neglected, and action under the regulations brought to light the fact that in almost every case it was due to an inability to get funds. The matter was very thoroughly discussed with the Kilimanjaro Planters' Association; it was pointed out to them that in the event of coffee plantations becoming so uncared for as to become an inducement to pests and diseases and a danger to neighbouring coffee then

that coffee must be eliminated, for under no consideration could Government allow any coffee to become a centre of infection of pests and diseases and a menace to the general welfare of the coffee planting community. The association concurred with this policy and the British, German and Greek sections of the association gave it their strong support. An immediate improvement in the position was seen.

85. With the fall in copra prices the need also became apparent for a stricter application of the Plant Pest and Disease (Coconut) Regulations, and coconut plantations in danger of extinction through pests induced by neglect, have been saved for the continued profit of the owners, and remain as territorial assets rather than dangers to other producers.

86. *Locusts.*—Extensive egg-laying swarms of the Migratory Locust (*Locust migratorioides*, R. & F.) appeared from the north in the months of November and December extending from Moshi District to the west, while the Desert Locust (*Schistocera gregaria*, Forsk) infested the country from the east of Moshi to the coast; little damage was done by the flying swarms. Hoppers began to emerge towards the end of December, and a poison-bait mixing station was opened at Himu and arrangements made to deal with all accessible hopper bands from Tanga to Mbulu. Mr. D. L. Blunt, Senior Agricultural Officer, Kenya, visited Moshi and a plan of co-operation for anti-locust measures was decided upon which ignored territorial boundaries and was designed to give the cheapest and quickest action against locusts in whichever territory they may be. Large increases in the planting of such subterranean food crops as cassava and sweet potatoes have been made by natives, as an insurance against possible famine through locust damage of grain crops.

87. Although the Mycologist has not been able to visit the circle during the period under review, it has been possible to send him suspected material, and the painstaking efforts which have been made by him have rendered his services of value to this area. In the matter of the so-called "amber-bean" in coffee so prominent during the season, some planters considered it to be due to some new and mysterious disease; the investigations of the Mycologist indisputably proved that it is due to *Nematospora* carried by Antestia, which bore out the conclusions of the Entomologist and other officers.

88. Other diseases of coffee are *Hemileia vastatrix* which was prevalent during the months of July and August; spraying with a Bordeaux mixture together with a "sticker" prior to the onset of the rains in March is strongly advocated. Root diseases of coffee due to *Rhizoctonia bataticola* was found on two estates on Kilimanjaro.

89. *Mexican Marigold* (*Tagetes minuta*), is a scheduled pest under the Plant Pest and Disease (Destruction) Regulations; it is so far confined to the Western Usambaras. Experiments were carried out for control measures by spraying, and it was found that a four per cent. solution of copper sulphate, at the rate of fifty gallons per acre proved effective if sprayed on to the weed at any time up to flowering. It is felt however that while Mexican Marigold taints milk and so can be a pest in grazing, under conditions of native agriculture on steep slopes it may be advantageous in that it prevents wash and also provides a green manuring when the land is dug. There is a belief that the weed renders the soil toxic to other crops; but this has not been

proved, and has not been seen in Lushoto; trials are being laid out to determine the effect of Mexican Marigold on the following crops.

90. *Legislation.*—Particulars of the prosecutions of native coffee growers made under the Plant Pest and Disease (Coffee) Regulations are given in paragraph 48 above. Five prosecutions of non-natives were made when two fines of Shs. 400/- and one of Shs. 500/- were imposed by the Court; judgment was obtained in the remaining cases.

91. The revision of the Coffee Industry (Registration and Improvement) Ordinance, and regulations to control the erection of coffee cleaning and curing works, have been under consideration.

92. *Marketing.*—The marketing of sisal, coffee and cotton has received reference above. A very great deal of attention has been given to the important subject of marketing additional to the work carried out on the Marketing Organization Committee which sat at Arusha in March. The world-wide nervousness which exists in practically every market is reducing each and every country to being a self-contained entity. The northern area of this Territory cannot afford to continue its importations of raw products which can be grown locally. The matter has been brought to the notice of the Chambers of Commerce and Planters' Associations which could do much to bring the merchant and the producer into closer contact to mutual advantage. Encouraging results have been obtained, and firms who have hitherto neglected local produce, are now intensely interested and have entered previously unexplored markets, and are arranging for an extension of their activities. There are healthy signs of increasing production, better marketing with increased cash sales, which augur well for the cultivator and trader alike, and one can look forward with quiet confidence to this portion of the Territory emerging from the present depression in a better position than ever it was before.

93. One planter at Ngare-Nairobi now produces excellent canned goods: meats, fruits, jams, etc.; all of which find a ready sale locally. Canning of stone and other fruits in the Usambaras will probably soon be made.

94. *Shows and Exhibitions.*—The Senior Agricultural Officer was responsible for the organization of this Territory's participation in the East African Agricultural Show held in January, 1931. Messrs. Sturdy and Sanders, District Agricultural Officers, were in charge of this Government's exhibit at Nairobi. Messrs. Bird and Company, Tanga, are to be congratulated in obtaining all the honours in the sisal section; the virile Usa Planters' Association also for their excellent district exhibit of coffee; and Messrs. Baldwin and Brett, Kibosho, for their coffee seed. At the Elizabethville Exhibition, the coffee exhibit of the Usa Planters' Association and the Ambangulu Tea Estates exhibit, both received high awards.

95. *Implements.*—(i) A new coffee pulper which removes the saccarhine matter from the parchment together with the pulp is in operation on Kilimanjaro and has caused considerable interest.

(ii) A comprehensive selection of spray pumps of all kinds made and demonstrated by the Entomologist has been most valuable to planters and has resulted in large orders being placed; the general position of pest equipment with estate and natives cannot, however, be regarded as satisfactory and steps are being taken to remedy this.

(iii) The first crude oil tractor in Tanganyika was imported during the year; its performance will be watched with interest.

96. In conclusion, the year has clearly demonstrated the need of co-operation between departments, and between officers, planters' associations, Native Authorities and others, if the Northern Provinces are to withstand the shocks which the planting and other communities have suffered and must continue to suffer for some time. Such team work has definitely existed and to it Administrative, Forestry, Veterinary, Educational and our own officers have unselfishly contributed: the results of this co-operation will be seen in a great increase of export products in the 1932 season.

A. J. Wakefield,
Senior Agricultural Officer,
i/c North-Eastern Circle.

ANNEXURE II.

North-Western Circle.

Bukoba Province—Mwanza Province—Tabora Province.

1. Staff—(*Not printed*).

Staff Movements.

2. The increase in staff made it possible to replace the agricultural assistants at Maswa and Nzega by agricultural officers and to post an officer to Musoma to carry out a complete agricultural survey of the district. When Mr. Savile proceeded on leave Mr. Edwards took over the Biharamulo District in addition to Bukoba until the arrival of Mr. Haarer.

Correspondence.

3. In all districts I would like to see a decrease in office work and an increase in the number of days on tour. The letters received and sent from this office were: Outward, 2,093; Inward, 2,463.

Tours.

4. During the period under review visits were paid to the Provincial Headquarters of the four provinces and to all district stations. The Mwanza, Tabora and Bukoba Provinces were toured in company with the Director of Agriculture. The total number of miles travelled and nights spent on tour were as follows:—

By car and motor lorry	4,090 miles.
Walking safaris	70 ,,
By motor boat	153 ,,
By air	180 ,,
Number of nights spent on tour	102.

In addition to the above two visits were paid to Bukoba and one to Musoma by steamship. A visit to Morogoro and Kigoma, and several to Shinyanga were made by rail.

5. Close personal touch was maintained with the officers of other departments engaged on work which had a direct or indirect bearing on the agricultural development of the Circle. Advice and assistance has been given when opportunity offered and close co-operation has existed between Agricultural Officers and the officers of the Administration, Veterinary, Tsetse Research, Sleeping Sickness and Forestry Departments. The commercial community particularly the ginners have received every assistance and the Director met them on two occasions to discuss and help them with their difficulties.

General.

6. The North-Western Circle comprises the Provinces of Bukoba, Mwanza and Tabora. The total population is approximately 1,681,000 natives. The principal tribes are:—

(a) the Wanyamwezi in the south;
(b) the Wasukuma in the centre;
(c) the Wazinza in the Lake Basin;
(d) the Wahaya in Bukoba;
(e) the Wakuria in Musoma.

7. There are three main Agricultural Areas:—
(1) *The Highlands.*—Bukoba, Bugufi (Biharamulo District) and North Mara (Musoma District).
(2) *The Lake Basin.*—A belt of land, approximately eleven miles in depth, along the shores of Lake Victoria and including the islands of Ukerewe, Ukara and Kome.
(3) *The Hinterland.*—This runs south, east and west of the Lake Basin and includes parts of the Mwanza, Musoma, Maswa, Bukwimba and Biharamulo Districts and the Tabora Province.

8. *The Highlands.*—The areas classed under "Highlands" lie between 4,000 and 6,000 feet above sea-level and have an average rainfall of over fifty inches per annum. The country is undulating. The hilltops are generally stoney and the soil shallow, but the slopes and valleys where most of the cultivation takes place consist of a fertile chocolate or brown loam admirably suited to agricultural development. North Mara in the Musoma District is still undeveloped, therefore Bukoba and Bugufi only can be dealt with at the present time. With a lucrative perennial crop like coffee and a staple food crop like bananas it is not surprising that the natives are indolent and perfectly happy with their lot. I was impressed with the general fertility of the Bukoba District and although the present methods of cultivation of coffee and the control of pests and diseases are a continual source of anxiety to the officers concerned. I feel that steady and satisfactory progress is being made and that, under the circumstances, the most we can look for is a gradual improvement over a period of years. As long as production can be maintained and disease kept under control I would like the improvements to come from the natives themselves as a result of our teaching. It is unfortunate that European planters in this area are few so that the natives have few opportunities of seeing coffee grown on plantation lines. It is hoped that the proposed grading rules to improve the standard of Bukoba coffee for export will slowly but surely compel the natives to adopt better cultural methods.

Bugufi.—A compact parcel of country ideally suited to agricultural development lying approximately 100 miles due west of Biharamulo. The area is approximately 250 square miles and has a population of over 26,000 natives. As in all concentrated areas force of circumstances have compelled the natives to adopt more intensive methods of agriculture and here the valley bottoms present a pleasing picture of intensive cultivation amidst a network of ditches and irrigation furrows. Coffee cultivation is still in its infancy and great care is being taken to control and develop it along sound lines in order to prevent a repetition of the Bukoba troubles.

9. *The Lake Basin.*—The areas included under this title enjoy a rainfall of over forty inches. The natives are keen agriculturists. The infestation of tick is great and east coast fever is prevalent therefore they devote their

energies to arable farming. This area has shown steady progress and with the increase in staff more attention is being paid to its development. Cotton, rice and simsim are the chief economic crops grown. The bulk of the soil consists of a sandy loam but the average yields per acre are satisfactory owing to the high water table and favourable distribution of rains.

10. *The Hinterland.*—The rainfall varies from thirty to forty-five inches. It is unreliable and its distribution generally unsatisfactory. The average yields per acre are low and arable farming will always be a risky proposition in these areas. There are patches of fertile soil scattered over the area. The fertile black loam at Lubaga and the chocolate loams of Ibadakuli are examples but generally the soil is of a light sandy nature with no capacity for retaining moisture. The permanent fertility of the soil is difficult to maintain and the rotation of land instead of crops is the general practice. Groundnuts and cotton are the principal cash crops. The yield of groundnuts per acre grown as a pure crop is fair and can be improved but the yield from the present type of cotton ("Uganda Upland") is low and even in normal years gives a poor return to the natives for their labour. The natives are pastoral farmers and the wealth of the areas lie in the vast numbers of stock they carry. It is unfortunate that in the past there has been no co-operation between this Department and the Veterinary Department in the way of improvement of pastures or the propagation of fodder crops in these over-stocked areas. Unless a large reduction of stock takes place the agricultural development of these areas must be concentrated on the increased production of crops for stock feed to check the ever increasing number of deaths from starvation.

11. *Experimental Stations.*—A separate detailed report of the work being carried out at the Tabora-Mwanza Experimental Station has been submitted by the District Agricultural Officer, Shinyanga. Mr. F. A. Stockdale, Agricultural Adviser to the Secretary of State, and the Director of Agriculture visited the station last December and reviewed the work that had been done in the past. The experiments of previous years have been continued but more work is being carried out in selections from local types of sorghums, millets and grasses. Additional crops, such as sunn hemp, are being tried as green manure crops. The control of white ants at Ibadakuli has presented great difficulties and so affected the results of the experiments that the bulk of the experimental work is now being carried out at the Lubaga seed raising station. Approximately 100 acres have been set aside for this purpose.

12. *Agricultural Sub-Stations* (Seed Farms).—Details of the agricultural sub-stations are contained in the separate reports of the District Agricultural Officers. The value of seed farms in demonstrating to the natives improved methods of agriculture is unquestionable and in fact is the only way to get any effective results. The native is conservative. He is loath to change his methods but by continually demonstrating to him the improved yields obtained from planting at the correct time and spacing the crops correctly he is gradually beginning to give up his old methods and adopt the new. This is particularly the case with the groundnut crop. The only pertinent criticism that I have heard from the natives has been to the effect that all the wonderful work they have seen is very good and they agree with everything we have told them but after all they have only their wives and children to help them while we have employed paid labour. During the recent increased production

campaign I impressed upon all concerned that an increase in production did not necessarily mean an increase in acreage but that the results could be obtained by concentrating on better methods of planting and correct spacing. This has been proved by the work that has been carried out on the demonstration farms. I quote the criticism of the native cultivators to show that if he found it difficult before, any policy which advocates increased acreage as the only means to increase production is a retrograde step in agricultural development and makes it impossible for the native to follow our methods and still remain a no-cost producer.

13. Apart from the value of sub-stations to the native their value to the District Agricultural Officer must not be overlooked. He gets valuable and accurate information regarding crop yields and costs of production which enable him to give advice regarding the economic development of the district along sound agricultural lines. Large numbers of small sub-stations thirty to forty acres scattered throughout the various districts have proved uneconomical and difficult to supervise. These are being replaced by small demonstration plots of one or two acres under the charge of the native instructional staff and one large central seed farm in each district will be established.

14. *Ploughing.*—The first introduction of ploughs on a large scale took place in 1923-24. Ploughing schools were established in all districts where ploughs were introduced. Large numbers of natives received instruction in ploughing and in the preparation of hides for reins and strops, and large numbers of oxen were trained. The results of years of hard work and propaganda have been unsatisfactory. Ploughs are only used by a few chiefs and headmen and a very few natives. At the present stage of agricultural development I do not consider that ploughs are either essential or beneficial to the individual native cultivator. In the process of time some natives will become "farmers" in the true sense of the word and the plough will then come into its own. The native reply might well be quoted to show the social point of view: "At the present time our wives create enough trouble and if they had not the fields to hoe we do not know what would happen." The average native cultivator is really a gardener and it is wellnigh impossible to convince him that the increased acreage he would get by using a plough justifies the initial expenditure, the cost of upkeep and the risk of losing his cattle. Trials are being carried out with a simple form of wooden plough with an iron point. It can be drawn by two oxen and worked by one man. Made locally it costs about Shs. 12/-. Its work is equal to that done by a native hoe but is much quicker. Time is an important factor and it is hoped that this cheap and simple implement will find more favour with the natives than the more expensive modern ploughs.

15. *Cotton Seed Distribution.*—All seed requisitioned by Government was paid for at current market rates and the utmost economy in its distribution was exercised by all officers. The interest of the native in cotton cultivation is fast waning. Low prices coupled with low yields and late rains had disastrous effects. In the hinterland especially in the Shinyanga District large quantities of seed taken by the natives were never planted. It is hoped that the satisfactory results obtained from the U/4/4/2 type of cotton will act as

a badly needed stimulant to cotton production. When sufficient seed is available for distribution to the natives it will mark the opening of a new era in cotton cultivation and production in the three provinces and will undoubtedly have a decided influence on the future of the native cotton industry. The total seed distribution for the present crop was 721·4 tons compared with 1,111 tons last season. The total expenditure incurred in connection with the purchase and distribution was Shs. 23,539/50 or approximately Shs. 31/- per ton.

16. The bulk of the cotton seed for next season's crop was placed at the distribution centres by the end of November. The increased production of cotton has been actively encouraged. The quantities of seed made available for distribution were as follows. Last year's figures are given for comparison :—

	Cotton seed distribution (in Tons). 1930/31	1931/32
Mwanza Province	597	752
Tabora „	102	40*
Bukoba „	22·4	—
Total ...	721.4	792

*25 tons of 4/4/4/2.

Fifty-eight tons held in reserve.

The Mwanza ginners have given 149 tons free for distribution in the areas their ginneries serve. Owing to the paucity of population and the scattered nature of the areas suitable for cotton growing in the Biharamulo District the cultivation of this crop has been abandoned and no seed was made available for distribution this season. It will be noted that the distribution of U/4/4/2 seed has been confined to the Shinyanga District. The seed was obtained from the seed propagated on the Lubaga seed farm.

Marketing Improvement and Extension.

17. *Cotton.*—The facilities for marketing the cotton crop were ample. Government exercises a certain amount of control. The overhead charges involved under the present system have been out of all proportion to the crop. It has been argued that increased marketing facilities in backward areas increase production but in the opinion of the writer it has in several cases checked their development. Each firm has been striving for the control of the industry in the main producing areas and the areas of low production have suffered. By allowing motor lorries to operate in any field without restrictions, which is equivalent to removing Government control on the number of markets, the need for ginnery buying posts has been nullified and the result has been that enterprising and energetic firms have fleets of motor lorries which will gradually force a number of buying posts and even ginneries to close down. When the number of buying centres and ginneries has been reduced to a minimum then Government will be able to exercise control of the industry without the necessity of employing a large and expensive staff.

The following facilities existed in each province for the marketing of the cotton crop :—

Cotton Markets.

	Markets	Ginneries	Ginnery Buying Posts
Mwanza Province	16	10	8
Tabora „	—	2	5
Bukoba „	—	—	2
Total ...	16	12	15

18. *Groundnuts.*—Groundnuts are purchased by Indian and Arab traders. The system of payment is part cloth and part cash. In the past attempts on the part of European firms to buy direct from the natives for cash met with little or no success, and they were content to advance the money and leave the purchasing of the crop to the small traders. The past season revealed that the natives were paid far below the market value for their crop. Large firms purchased groundnuts from these traders for cash but they would not give advances. The result was that barter was the chief means of trade. When the position was realized the Administration took steps to organize markets and this department arranged for money to be advanced to enable cash payments to be made. By this time the bulk of the crop had been disposed of for unnecessary pieces of cloth, salt, beads, etc. I consider that the first essential step in the marketing of groundnuts is to stop barter and make cash payments compulsory.

19. *Rice.*—This crop is bought by European, Indian and Arab traders. The East African Rice Mills own rice buying posts at the following places in the rice producing areas in the Lake Basin. At these posts the system of payment is cash :—

Ukerewe Island:
1. Multanga.
2. Ssisu Island.
3. Buguza.
4. Kamea.
5. Riangalla.

Ukerewe Mainland:
6. Kisoria.
7. Iramba.
8. Kibara.

Ukara Island:
9. Buysia (Buyesa).
10. Kifulle.

Majita:
11. Bukima (Butata).

Usukuma:
12. Kayenze.
13. Nyanguge.
14. Nassa.
15. Bukumbi.

20. Complaints of adulteration and damp paddy were received and several samples were examined. Investigation showed that native paddy contained as much as 4 per cent. foreign matter whereas samples taken at the mills showed as much as 13 per cent. The causes of adulteration were considered to be :—

(1) the carelessness of the native when threshing ;
(2) the careless handling and storage methods of the trader ;
(3) unwholesome competition between small traders who buy whatever paddy, clean or dirty, the natives offer for sale ;

(4) adulteration increases in proportion to the number of traders who handle the crop before it reaches the miller.

Rules to improve the quality of the rice and prevent the sale of damp or adulterated paddy are under consideration.

21. *Coffee.*—The marketing facilities for this crop are ample although the system might be improved. An average of 5,000 native itinerant traders purchase the crop for agents situated in Bukoba. Owing to complaints about the quality of the coffee it was deemed necessary to introduce inspection and grading rules in order to improve the quality and prevent wet or moist coffee being exported. These rules will probably come into force next April.

22. *Tobacco.*—The Biharamulo crop was purchased by The Tanganyika Industrial Tobacco Company, Dar es Salaam. The crop was prepared and baled by the department. As the crop increases the above firm will require to appoint local agents to handle it otherwise the bulk of the crop will be made into native coils and sold locally.

23. In reviewing the marketing of crops during the past year an extract from my report on markets and marketing will not be out of place: "With natives it can be safely assumed that the easiest means will be chosen to reach any desired end. In the days when communications were poor and there was little or no direct touch maintained between distant villages it is readily conceived that barter was the only means of trade in native communities and villages. In years of famine, sheep and goats, etc., were exchanged for millets and other food crops. The wants of the natives were few and easily satisfied. Habits change but slowly and we still find that barter is the chief means of trade." From observations on the present methods it is considered that the average native does not receive a fair market value for his produce and, before any effective organization can take place, all produce must have a definite value in terms of cash. This will help the native to determine the relative value of his various crops and encourage increased production of export crops. It will further eliminate the undesirable type of small trader, encourage reputable firms and increase their feeling of security. No general rules can be laid down. Each individual province or district must study its own problems; apply general principles and work out its programme.

Crop Production.

24. *Coffee.*—This crop is practically confined to the Bukoba and Bugufi Districts of the Bukoba Province. Unsuccessful attempts have been made to establish coffee nurseries in Northern Uzinza, Mwanza Province, and at Nyawa, Tabora Province. During the present season Messrs. Haarer and Edwards, who have had vast experience in coffee cultivation, assisted by three Coffee Officers (one employed by the Native Administration, Bugufi) have been engaged in improving the native coffee industry in the Bukoba and Bugufi Districts. The Director of Agriculture visited Bukoba and Bugufi and the Assistant Entomologist visited Bukoba. Various problems were examined and improvements suggested on the spot.

25. The present season's export figures place the crop at approximately 6,600 tons but considering the reluctance of the natives to pick and sell their crop at the present low prices the latter figure cannot be taken as representing

the total yield. Full details of the production and value of the crop is contained in the annual report of the District Agricultural Officer, Bukoba. Coffee cultivation in Bugufi is still in its infancy. Nurseries for the propagation of Robusta were established in 1925-27. It was considered that Arabica was more suited to the area and nurseries were opened in 1929. In 1930, 10,000 seedlings of Arabian coffee were ready for distribution. The activities of the department were so numerous in the Biharamulo District that one officer was unable to devote the whole of his time to the development of Bugufi and a Coffee Officer was engaged by the Native Administration. The cultivation of what promises to be a profitable crop for the area has progressed rapidly during the year and coffee nurseries have been established in all villages in the coffee belt.

26. *Cotton.*—The main cotton producing areas lie in the Lake Basin. The type of cotton at present grown is "Uganda Upland". The average yield even in normal years is low, the best plantations producing not more than 400 lbs. per acre. Further trials with the U/4/4/2 type introduced from Barberton, South Africa, were carried out in all cotton growing areas and over 100 acres were planted at Ibadakuli for the propagation of seed.

27. The results of the trials were as follows :—

District	Place	Yield in lbs. per acre
Shinyanga ...	Lubaga	976
	Experimental Station ...	466
Mwanza... ...	Ukiriguru	273
Kwimba ...	Manthare	305
	Ngudu	272
Maswa	Sengerema	147
	Shanwa	129
	Nassa [Lake Basin] ...	500
Biharamulo ...	Kigombe	171

Mr. S. Milligan, of the Empire Cotton Growing Corporation, visited the Circle towards the end of August to examine the conditions under which the U/4/4/2 cotton was being grown and to advise generally regarding the suitabilities of the areas for cotton cultivation. He was pleased with the behaviour of the U/4/4/2 at Lubaga, Ibadakuli, Ukiriguru, Manthare and Ngudu but expressed the opinion that at Lubaga quality had been sacrificed for a large yield, there being insufficient moisture to finish off and strengthen the staple. Where the yield was lower the staple was stronger. Mr. Milligan considered we were on the right lines and did not think it worth while trying out other varieties from Barberton. He visited Ukerewe Island and Nassa on the Lake shore where he examined samples of the "Uganda Upland" cotton and spoke highly of its quality and strength of staple. The areas were very suitable for cotton and he did not think it advisable to introduce the U/4 type but suggested that selections from Uganda might be tried out.

28. Cotton in the Biharamulo, Kahama and Nzega Districts proved a failure. The total cotton production was as follows :—

Province	1st Quality	2nd Quality	Total
Tabora	— ...	— ...	172,861
Mwanza	7,165,031 ...	8,681,991 ...	1,516,960
Bukoba	1,954 ...	962 ...	2,916

The range of prices were as follows :—

Province	1st Quality		2nd Quality	
	Maximum	Minimum	Maximum	Minimum
Tabora	8 ...	4 ...	4 ...	1
Mwanza	8 ...	4 ...	2 ...	1
Bukoba	4 ...	2½ ...	1 ...	1

The total crop produced 7,011 bales.

29. *Groundnuts.*—In the Hinterland this is the principal cash crop. It has always been a popular crop with the natives and the increased yields obtained when grown as a pure crop correctly spaced is finding favour in many areas. On the demonstration farms the groundnut hay is stacked and fed to the cattle. It is hoped that the natives will soon follow this example. Unfortunately last year's low prices coupled with the poor rains had disastrous effects on production and a considerable decrease in cultivation was reported from all areas. From a record production last year the export figures for the present season fell to 3,256 tons.

30. *Rice.*—The cultivation of this crop is mainly confined to the Lake Basin and the Islands. The rice grown in the Hinterland is usually only sufficient to supply local demands. Rice is a popular crop with the natives and its production has steadily increased. In 1907 the total production was estimated at 800 tons while in 1930, 14,000 tons of paddy were produced and export figures showed a total of nearly 6,000 tons. Owing to locust and adverse weather conditions the present crop was estimated at 10,000 tons paddy and the export figures were 3,987 tons. The main varieties grown are Senna and Maji-maji with Bungala and Afa in smaller quantities. Afa commands the highest price with Maji-maji the lowest on the scale. Attention is being paid to the propagation of Bungala and Shs. 200/- have been set aside by the Ukara Native Treasury for this purpose. Selections and trials of local varieties are being carried out by the District Agricultural Officer, Musoma, and two acres of land for experimental purposes have been reserved on the rice estate of The East African Rice Mills. Owing to the locust danger the natives in the main rice growing areas show reluctance to increase their plantations.

31. *Sesame.*—The cultivation of this crop is mainly confined to Ukerewe Mainland and Musoma District. It is grown mixed with millets and sorghums. The production which has remained steady at about 600 tons was increased to 1,500 tons, the export figure being 1,367 tons.

32. *Cassava.*—In the past years, particularly in 1930, the cultivation of this crop has been encouraged as a food reserve crop in case of a failure of the grain crops. In connection with the anti-locust campaign natives are

compelled to grow it as a safeguard against famine with the result that in some districts large quantities are available for export. During the present year it ranked as the chief export crop from the Nzega District. Tabora Province exported 1,136 tons.

33. *Tobacco.*—The results of trials carried out in the Biharamulo District have proved satisfactory and tobacco has taken the place of cotton in this area. The "Heavy Western" type of Nyasaland tobacco was planted and the yield estimated at 400 lbs. per acre. Great difficulty has been experienced in finding a popular and suitable cash crop for the Kibondo District of Kigoma Province and for the sleeping sickness concentrations in Kahama District. Tobacco appears to promise a fair cash return to the natives and it is hoped to extend the tobacco growing belt from Biharamulo to Kahama via Kibondo. First and second grade were sold in Dar es Salaam for Shs. 1/50 and Sh. 1/- per kilogram and on visiting the tobacco factory I was assured that the demand for this type of tobacco was far in excess of the supply and they would purchase any quantity. Native coils made from this tobacco sold locally at 24 cents per pound and the District Officer informed me that the natives preferred this tobacco to the locally grown types and that Bukoba and the Belgian Congo offered a very large market. A limited number of nurseries have been established. The number will be increased as more trained native staff become available. Mr. Allinson, Agricultural Surveyor, Sleeping Sickness Department, visited Biharamulo during the present season and he will return next year to study the methods of cultivation and curing in order to establish a native tobacco industry in the sleeping sickness concentrations. Tobacco is a popular crop and approximately 23 tons of native tobacco were exported during the season.

34. *Other Crops.*—Sorghums and millets and to a lesser extent maize are the staple food of the natives in the Mwanza and Tabora Provinces. In the Bukoba Province bananas and beans form the staple diet. Very little is exported. The surplus in good years is stored as a reserve in case of poor crops the following year.

Pests, Diseases and Vermin.

35. *Cotton.*—No serious disease affected this crop. Aphis, Jassid hoppers and Stainers were prevalent but not in sufficient quantities to do any considerable damage. In the Hinterland white ants did a certain amount of damage to young cotton. Increased numbers of rats were reported in all areas and damage was done to seed cotton especially in the Maswa District.

36. *Cereals.*—A parasitic flowering plant (*Striga* sp.) known locally as "Kiduha" was particularly noticeable in the maize and sorghum plantations. The effect of this weed is well known to the natives and the native instructional staff encouraged natives to hand pick it before it reached the seeding stage.

37. *Coffee.*—The principal diseases of coffee in the Bukoba District are the coffee bean borer (*Stephanoderes* sp.) and the coffee bug (*Antestia* sp.).

38. *Groundnuts.*—The incidence of rosette disease varies from year to year. During the present season a very small percentage of plants were infected except in the Mwangoi Chiefdom, Nzega District, where the incidence was as high as 60 per cent. in some crops.

39. *Game.*—Damage by game is confined to certain localized areas. Porcupines, baboons, pigs, zebra and, round the Lake shore, hippopotami do the most damage.

40. *Locusts:* First Campaign.—Swarms of migratory locusts were first observed in the Musoma District on the 4th February. They arrived in North Mara from Kenya. The general direction of flight was south-westerly following the shores of Lake Victoria. The swarms were reported in the Maswa District on the 5th and 6th and reached Mwanza on the evening of the 6th February. On the 10th they had got as far south as Shinyanga and reports of locust movements were received from Kahama and Nzega. On the 9th March a steady stream of swarms of mature locusts began to arrive in North Mara from Kenya. Reports of the invasion of flying locusts were received from practically all areas lying between 1° and 5° South and 31° and 36° East. Locusts from the first invasion were reported pairing on the 4th of March and egg-laying over an extensive area was reported from Kizimbi in the Shinyanga District. Egg-laying was reported from all parts of the Musoma District, with the exception of Majita, and from five areas in the Maswa District and in the southern areas of Mwanza.

41. *Hopper Emergence.*—On the 21st March the emergence of hoppers on a ten-mile front was reported at Kizumbi in the Shinyanga District, and by the 6th April the emergence of hoppers had been confirmed in the Mwanza, Musoma, Kwimba, Maswa and Shinyanga Districts while egg-laying had been confirmed in the Bukoba District.

42. The campaign now began to assume serious proportions. Shinyanga, where the hoppers were advancing on a 16-mile front, was considered the most important area and staff and equipment were concentrated there. It was soon realized that the Musoma, Maswa and parts of the Mwanza Districts were equally badly infested and that the available staff were incapable of dealing with the situation in all areas. The infestation was too great to cope with without the expenditure of large sums of money. The situation in Uganda and Kenya was also serious and no guarantee could be given that even if all the hoppers in Tanganyika were destroyed this would save the food crops from flying locusts. It was decided that the available staff in the affected areas should concentrate on the destruction of hoppers in and around the shambas and so save the food crops while extra staff and equipment would concentrate on the destruction of hoppers on the southern front and gradually work up towards Musoma.

43. There were three distinct periods of egg-laying :—

(a) About the 10th March,
(b) ,, ,, 24th ,,
(c) ,, ,, 10th April.

The egg incubation period was from twelve to fourteen days. The number of moults to the adult stage was usually five and the period taken from forty-five to fifty days. If the food crops were to be saved the destruction of the hoppers from the first and second egg-laying was of prime importance. The failure of bran bait was a disappointment. The cheapest and most effective means of destruction proved to be spraying with a solution of sodium arsenite (five to six ounces per four gallons of water). Trenches dug at right angles

to the line of march and partly filled with brush-wood proved most effective. The hoppers concentrated on the brush-wood and power and hand sprayers operating along the trenches did effective work. In areas where firewood was easily obtainable the trenches were filled with hot ashes and the hoppers driven into them. Dusting with sodium arsenite proved effective but expensive and dangerous in cattle areas. Towards the close of the campaign when everything was burnt and dried up success was obtained with bran bait.

44. Throughout the campaign the hoppers and locusts showed a marked preference for grass and it was only when this was scarce that any considerable damage was done to food and cash crops. The following crops remained untouched: Sweet potatoes; cassava; gram; beans; simsim; pumpkins; cucumbers, etc. The following crops were only touched in exceptional cases: Rice; cotton; groundnuts; banana leaves. The following crops were readily eaten when in the young stage: Sorghums and millets; eleusine; maize.

45. Considerable damage was done to rice through the locusts settling on the crop and breaking off the heads.

46. On the whole very little damage was done to food crops. Musoma District where the infestation was greatest and most difficult to cope with suffered most, and when the hoppers reached the flying stage the general tendency was to fly north so that the crops which escaped destruction from hoppers were destroyed by flyers. This was predicted in the early stages of the campaign. Famine relief measures were necessary in Musoma and Ukerewe Mainland where the food crops were completely destroyed and in isolated districts in Mwanza where twenty tons, ten tons and nine tons of food were sent to the Busisi, Buyombe and Usambiru areas respectively, as a precautionary measure. As an anti-famine measure the natives were compelled to plant areas of cassava and sweet potatoes which has stood them in good stead during the present invasion.

47. The following was the cost of operating the campaign in the various areas. Equipment and poison, etc., have not been included:—

	Shs.	Cts.
North-Western Circle (general)	1,393	55
Shinyanga	5,868	44
Musoma	3,142	86
Maswa	2,203	90
Mwanza	2,924	32
Bukoba	1,758	83
Mkalama	1,000	00
Kasulu and Kibondo	826	70
Biharamulo	343	42
Total ...	19,462	02

48. It is considered that the money was spent to advantage. The prompt action taken and the energetic manner in which the campaign was conducted in the Shinyanga and Maswa Districts reflect credit on the officers of the department and undoubtedly saved the food situation in other areas. Although this department was largely responsible for the organization of the

campaign and the carrying out of the destructive measures, the success attained was due to the whole-hearted support of the Administration and to the co-operation of other departments particularly the Veterinary Department.

49. Annexure I gives the field staff employed in the first campaign. (*Not printed*).

50. *Second Campaign.*—From the close of the first campaign in July intermittent reports of flying swarms were received from all areas. Egg-laying commenced in December and another anti-locust campaign was launched. The swarms are mixed, consisting of the desert locust (*Schistocerca gregaria*, Forsk.) and migratory locusts (*Locusta migratorioides*). The larger percentage being of the latter. The general direction of flight is south-west. The egg-lain areas are generally smaller and scattered over a much larger area. Reports indicate that large areas of uninhabited or sparsely populated bush country lying to the east of the Mwanza and Tabora Provinces and in Northern Bukoba and Biharamulo are infested with egg-laying locusts. This will add to the difficulty of the campaign as the crops will have reached the critical stage when hatchings in these areas have reached the flying stage. It is anticipated that the critical period in the present campaign will be March or April of next year.

51. The infested areas lie between 1° and 6° South. This campaign is being conducted along similar lines to the last, the main efforts being directed towards saving the crops. The compulsory planting of cassava and sweet potatoes as a safeguard against famine has met with active response from the natives generally. A noteworthy feature of the campaign to date has been the damage done to hopper bands by rain birds. In many cases small infestations have been completely destroyed by these birds.

Legislation.

52. *Cotton Uprooting and Burning.*—The dates fixed were :—

Northern Tabora	...	30th September.
Mwanza	...	31st October.
Ukerewe Island	...	30th November.
Biharamulo ...	...	31st December.

53. *Cotton Cess.*—Payment was made on lint instead of on seed cotton. The rate fixed was Shs. 6/66 per bale of 400 lbs.

Re-afforestation.

54. The need for shelter belts and wind breaks in parts of the Hinterland has long been emphasized, especially in the cotton growing areas. High winds are prevalent in the months of June and July when the cotton bolls are bursting. Sorghums, maize and millets which afforded protection to cotton in its early stages have been harvested and the stalks eaten or trampled down by the cattle. The results of these high winds on the cotton crop and the resultant low yields obtained are only too apparent. The shortage of firewood and building material; the disastrous effects on over grazed pastures due to wind erosion and probably least of all the necessity of shelter belts for the protection of crops have led to the planting of wind breaks in the Shinyanga,

Kwimba and Maswa Districts. These wind breaks consisting of rows of *Cassia siamea* are planted as far as possible at right angles to the prevailing direction of the wind. The seeds are planted *in situ*. The plants grow rapidly and have the great advantage of being immune from white ants. This work is being carried out by the Administration in co-operation with the Forestry and Agricultural Departments. Nurseries of *Cassia siamea* were established at agricultural sub-stations but the results obtained from transplanting proved unsatisfactory.

55. Particular attention is being paid to wind breaks and shelter belts in the Kwimba District. The large open wind-swept plain is now broken up by belts of young trees stretching for miles across the plain. The soils are fertile but the yields are low because insufficient moisture is retained in the soil to mature the crops. The effects of these wind breaks will be felt in the next few years and the Administration are to be congratulated on re-laying the foundations of what was once a fertile agricultural area. The results on pastures and crop yields will be watched with interest.

Roads and Communications.

56. The increase in agricultural production that has taken place in the last few years and the present prosperity enjoyed by the natives in the areas dealt with in this review are largely due to the excellent net work of roads and the transport facilities provided by the railway, steamship and dhow services.

57. *Roads.*—The main trunk road runs from Tabora to Mwanza passing through the Administration headquarters of the Nzega and Shinyanga Districts. From Tinde, midway between Nzega and Shinyanga, another trunk road branches off to Bukoba passing through Kahama and Biharamulo Districts (there is also a main road from Tabora direct to Kahama across the Gombe River but it is badly infested with "fly" and should be avoided if possible). At Mabuki on the Tabora-Mwanza Road there is a branch road to Ngudu and Shanwa. Musoma can be reached by road from Mwanza. From Bukoba the road runs to Uganda and from Tabora, Nzega, Shinyanga or Mwanza one can go by road to Dar es Salaam, Arusha or Nairobi. All districts in the Circle are accessible by road during the dry season. From these main roads branch roads run to all parts of the districts connecting up the principal trading centres with the railway stations or the ports of Mwanza, Bukoba and Musoma.

58. *Railways.*—At Tabora on the central railway a branch line runs to Mwanza. The distance is 237 miles and there are thirteen intermediate stations. The following table shows the distances of Administration headquarters from the railway :—

District	Railway Station	Remarks
Tabora	Tabora ...	—
Nzega	Bukene ...	24 miles to Nzega
Kahama	Isaka ...	27 ,, ,, Kahama
Shinyanga	Shinyanga ...	—
Shanwa	Malampaka ...	25 miles to Shanwa
Kwimba	Bukwimba ...	12 ,, ,, Kwimba

59. *Steamship Service.*—There is a fortnightly service between Mwanza and Kisumu.

60. *Dhow Service.*—Dhows ply between Mwanza and Kisumu and all ports on the Lake. The transport rates are cheaper but no insurance against loss can be entertained. Small traders and merchants who are willing to take the risk use dhow transport in preference to the steamer.

61. *Telegraph.*—With the exception of Musoma, Kwimba and Shanwa, all other districts are in direct telegraphic communication with this office. The telegraph office for Shanwa and Kwimba is at the railway stations 25 and 12 miles respectively from the bomas.

62. *Telephone.*—There is a trunk service between Mwanza and Mabuki, Shinyanga, Nzega and Tabora. Musoma is the only district which is really cut off from telegraphic or telephonic communication.

Kigoma Province.

63. As this province only came under this Circle in November no reference has been made to it in this report. Separate reports by the District Agricultural Officer, Biharamulo, and myself have been submitted.

Conclusion.

64. The year has been marked by changes. The Agricultural Officer felt that he was ploughing a lone furrow and watched a fall off in the production of cash crops, a decrease in the acreage under cultivation, and a tendency on the part of the natives to reduce their plantings still further while he felt powerless to prevent it. Some areas which once had produced nearly 1,000 tons of cotton produced under 100 tons. Bukoba coffee export figures dropped by 1,000 tons; rice from 14,000 to 10,000 tons and from a record groundnut crop estimated at 23,000 tons to 5,000 tons. He witnessed the results of years of hard work and propaganda slowly but surely dwindling away and realized that all his efforts were to be nullified unless some means were devised to overcome the natural consequences of low prices, poor rains, locusts and all that went to make the agricultural depression a fact. Then came the Government's policy of increased production and the cloud of depression lifted, Agricultural Officers entered the field with a light heart only too willing to place their experience and knowledge at the disposal of the Administration. The response of the natives has been marvellous and everything points to a record season from this year's plantings. I would again stress the point that in considering the total acreage comprising the North-Western Circle the area of high productive land enjoying a reliable well distributed rainfall is small and if the agricultural possibilities of all areas are to be fully developed we should not, and cannot, keep the pastoral side of agriculture entirely separate.

A. S. Richardson,
Senior Agricultural Officer,
i/c North-Western Circle.

ANNEXURE III.

The South-Eastern Circle.

Lindi Province—Songea District, Mahenge Province.

The Lindi Province, together with the Songea District of Mahenge Province, now takes its place in the scheme of decentralization as the South-Eastern Circle. Departmental activity is under the general direction of a Senior Agricultural Officer with his headquarters at Lindi. The Circle had a field staff of four District Agricultural Officers and two Agricultural Assistants at the beginning of the year, but staff was later reduced to four Europeans owing to the resignation of one member and the retrenchment of another.

2. The staff of African Instructors was reduced from 31 to 25 during the year. This reduction was largely due to the curtailment of departmental activity in Kilwa following on the resignation of the District Agricultural Officer. At the end of December, 1931, the staff was stationed as below :—

Lindi-Mikindani	8
Masasi-Tunduru	8
Songea	8
Kilwa	1
	25

Touring.

3. The following table shows the number of nights that officers were absent from their station and the number of miles travelled. The mileage travelled on foot is merely the distance from camp to camp, and does not take into account detours and normal inspections of farms, gardens and plantations :—

By car and motor lorry	8,325 miles.
Walking safaris	2,401 ,,
Number of nights spent on tour	645

Correspondence.

4. A determined effort has been made to simplify the office routine of this Circle and to curtail correspondence without loss of efficiency. This has been aided by personal contact between the District Agricultural Officers and the Senior Agricultural Officer in charge. But a great deal of clerical work still falls upon officers who are primarily field officers. The only clerical assistance provided is one second grade African clerk in the office of the Senior Agricultural Officer. Some 3,000 letters have been received and 1,800 despatched. This shows a gratifying diminution in volume. It can confidently be asserted that the increase in field activity is proportionately greater than the falling-off of correspondence.

Weather and Rainfall.

5. The seasonal year does not coincide with the calendar year. Throughout this Circle the crop year really begins in October with the first showers. Rain normally falls in increasing quantity each month to January, a high rainfall is recorded in February and March, and then the rains slacken off appreciably until the end of May when the dry season can be said to commence. Thus the rainfall records for 1931 reflect the conditions in the latter half of the crop year and the early months of the next season. Generally speaking the rains were late over the whole area. On the coastal belt the main rains were high but localized and erratic. Over the inland districts the rainfall although late, and scanty in places, was not much below normal for the area.

General Remarks on Crop Production.

6. The Circle exports its produce through the ports of Mikindani, Lindi and Kilwa. The chief export product, sisal, is drawn from Mikindani and Lindi only, there being no sisal grown in Kilwa or the districts of the Hinterland. Copra is a product of all three coastal districts as also is cotton. The quantity of cotton coming from inland districts is negligible, but these inland districts, Newala, Tunduru and Masasi, contribute a large proportion of the other chief native export products, grain, simsim and groundnuts. Owing to the great distance from the coast and the high cost of road transport little produce is exported from Songea.

7. In the coastal area the grain crops were poor. Fortunately there was a considerable carry-over of grain from the bumper crop of 1930 and it is this carry-over that is reflected in the export figures for 1931. Very considerable damage was done by rats and this pest made it necessary for natives to replant their mtama several times. Swamp rice and simsim had a good year. The food position in inland districts was satisfactory, and most crops were well up to the average. Rat damage was severe in Newala as on the coast. Songea and Tunduru Districts were both recovering from the food scarcity of 1930. In the former district yields were somewhat reduced owing to the late opening of the rains, but there was no real shortage. Very good progress has been made in Tunduru in safeguarding the food requirements of the population. In Masasi, Tunduru and Songea some progress has been made with the cultivation of tobacco. As cash crops simsim, rice and tobacco are growing in popularity, while cotton has ceased to be attractive. There has also been increased activity in the collection of the forest products beeswax and gum copal.

8. An examination of export figures shows that the volume of exports has been well maintained, and in the majority of products the exports considerably exceed those of 1930 as the following table will show :—

	1930 tons	1931 tons	Per Cent. Increase
Sisal	4,099	6,242	54
Sesame	2,515	2,841	13
Mtama	1,520	3,531	132
Rice	992	1,211	22
Beeswax	44	78	75
Copra	349	488	40
Groundnuts	524	375	Decrease
Tobacco	77	120	55
Gum Copal	25	36	44
Cotton	162	34	Decrease

It is unfortunate that although the volume of exports has greatly increased there is no corresponding increase in value. The total value of exports has fallen from £178,564 in 1930 to £157,925 in 1931. This shortfall is almost entirely the result of the fall in sisal prices. With most native produce the fall in price was offset by an increase in production, and value thus maintained.

9. The following table gives the value of the chief export products from the three ports, Mikindani, Kilwa and Lindi :—

	Mikindani	Kilwa	Lindi	Province
	£	£	£	£
Sisal	14,825	Nil	54,647	69,472
Simsim	2,692	4,705	21,550	28,947
Mtama	2,416	3,694	9,243	15,354
Rice	851	1,911	6,801	9,564
Bark	6,838	unreliable	Nil	unreliable
Beeswax	minor	344	5,793	6,137
Copra	690	2,627	529	3 847
Groundnuts	1,342	minor	1,876	3,319
Tobacco...	minor	,,	2,664	2,965
Gum Copal	,,	1,365	minor	1,633
Cotton	Nil	Nil	1,440	1,440
Miscellaneous	1,567	—	921	—
Total ...	£31,221	£20,240	£105,464	£157,925

10. *Sisal*.—No estate closed down during the year but reduction of staff and wages has been general. The output of fibre was considerably greater than last year, but was nevertheless insufficient to maintain the 1930 level of value. The department's efforts to obtain the co-operation of estates in an economic survey of the industry did not meet with the active sympathy of the planters' association, and was abandoned.

11. *Simsim*.—The simsim crop is by far the most valuable native product of the area. The general fall in prices has affected simsim less than most other produce, and the crop has retained its popularity with natives. There has been a small increase over the 1930 crop. Reports indicate a further and substantial increase in production this season. Efforts have been made to maintain the "Lindi White" simsim, and seed has been multiplied on the Mwera tribal farm and on the Mpapura Experimental Station.

12. *Grain*.—The export of grain was almost entirely the carry-over from the good harvest of 1930. Little grain grown in 1931 was exported. The crop was poor and the price offered little inducement to natives to sell.

13. *Rice*.—Rice has become increasingly popular amongst natives as a cash crop. Prices have been fair in comparison with other produce and natives feel that in the event of low prices they can themselves utilize the crop as food and are not compelled to sell at unattractive prices. Rice cultivation has extended in Newala, and this season a dry season crop was raised in marshes and flood lands in Tunduru, land not previously cultivated, but which has now been brought under the hoe in the campaign to safeguard the food situation in that district.

14. *Beeswax.*—The total quantity of beeswax exported was 78 tons as against 44 tons in 1930, value £6,137. The value of this product now exceeds that of copra, groundnuts, tobacco, gum copal or cotton. The low price for field produce has stimulated the collection of both beeswax and gum copal.

15. *Copra.*—There has been a small revival of interest in copra, resulting in an increase of 139 tons in export, but production is very much below normal and represents only a small fraction of the potential output of the plantation. Plantation owners find it more profitable to sell nuts retail than to make copra. An intensive campaign has been waged to maintain the plantations in a state of health in spite of the depression, and a distinct improvement is to be noted in Lindi and Mikindani.

16. *Groundnuts.*—The crop was below normal. Rosette disease was prevalent in Masasi, and in Tunduru there was a shortage of seed following on the hardships of 1930. An effort has been made to stimulate the cultivation of this crop and seed of the Virginia Bunch variety, which does not appear so susceptible to rosette, has been multiplied and distributed. The rosette disease is a very real menace and unless the new seed proves immune a further reduction in yields is likely.

17. *Tobacco.*—The export of tobacco has increased steadily since 1927: 13 tons, 33 tons, 64 tons, 77 tons and 120 tons in 1931. The bulk of this tobacco is native roll tobacco grown in Tunduru, Songea and along the Rovuma River. An attempt is being made to teach natives to produce a better class of tobacco. A start was made in 1929 with the introduction of Heavy Western tobacco from Nyasaland. The District Agricultural Officer was sent to Nyasaland to study methods of growing, curing and marketing, and on his return was stationed in Songea. The natives are now being taught to produce a fire-cured leaf suitable for cigarette manufacture for the Territory's internal market. Some progress is to be reported. Nearly two tons of leaf was exported in 1930 and this season production rose to a little over three tons. The constant work and supervision necessary for the successful production of tobacco suitable for manufacturing purposes does not greatly appeal to the natives as yet, and progress is and will be slow. The introduction of this class of tobacco and instruction in fire-curing was extended into Tunduru and Masasi Districts this season. All the fire-cured leaf was marketed by the department; the leaf was purchased outright from natives baled, and then sold to manufacturers in Dar es Salaam.

18. *Cotton.*—This year cotton ranks amongst the minor exports. With the fall in prices there has been a rapid decline in the area planted. The following table shows how production has been related to price fluctuations:—

	Tons Seed cotton	Average Price Cents per kilo	
1924 ...	598	... 52	
1925 ...	897	... 44	
1926 ...	507	... 27	
1927 ...	420	... 39	
1928 ...	581	... 39	
1929 ...	813	... 37	(Falling to 25 at end
1930 ...	273	... 16	of season)
1931 ...	57	... 10	

The following remarks are taken from the report of the District Agricultural Officer, Lindi-Mikindani:—

> "In 1930 there was a greater estimated acreage of cotton than in 1929 but as previously reported a large part of the crop was left unpicked. The acreage in 1931 was estimated at rather less than one-third of that for 1930, but unpicked cotton was still more common than in the previous year in spite of the efforts made to induce natives to save the crop. The 'rot' is obviously taking its course in a very much more decided fashion than after the drop of 1926 and unless some direct action is possible the prospects for 1932 are discouraging. It is not considered likely that the present cash crop campaign will affect cotton production to any considerable extent. It will probably check the decline, but increases in production are more likely to be reflected in the simsim and rice crops."

Experimental Station and Seed Farms.

19. The work of the Agricultural Station at Mpapura is given in the report of the District Agricultural Officer. Owing to shortage of staff and the curtailment of the financial provision the scope of the station was restricted to field trials and seed multiplication and no accurate experimentation could be undertaken.

20. The work of the Mwera tribal farm at Mnacho (Lindi) has been reorganized by the District Agricultural Officer under whose energetic care very satisfactory progress has been made. This farm has been utilized both for seed multiplication and demonstration purposes. Kenya Hybrid maize has been multiplied to replace local native maize, and has proved both suitable and popular. The multiplication area has been considerably increased for the coming season. The other main work of the seed farm has been the multiplication of Virginia Bunch groundnuts and Lindi White simsim. The spread of rosette disease throughout the groundnut area is very serious, and it is hoped to replace the old strains with clean Virginia Bunch seed. Anxiety has been felt for some time over the deterioration of "Lindi White" simsim, a recognized product on the European market. The anxiety is caused by the increasing percentage of dark and small seed present.

21. Lack of funds hampered the Masasi Native Administration farm and little could be done. For the coming season the reserve funds of the Native Treasuries have been drawn upon, a new site on virgin land has been cleared, six acres of Virginia Bunch groundnuts, five acres of white simsim, and an acre of Heavy Western tobacco have been planted. The groundnuts and simsim are for seed distribution and the tobacco is a demonstration, and a possible source of revenue. The Tunduru seed farm was discontinued owing to lack of funds, but has been revived for the coming season. It is similar to the Masasi farm, but Potchefstroom Pearl maize is being grown in place of simsim.

22. In Songea two progressive tribal farms have been maintained one by the Federated Ungoni Council, and the other by the Wamatengo and Wanyasa jointly. At both these farms the growing and fire-curing of tobacco was made a feature. A considerable amount of Kenya Hybrid maize has been raised for general distribution. Songea District is well favoured by soil and

climate for the production of a great variety of crops for, in addition to the usual foodcrops grown by natives throughout tropical Africa, it is possible to grow a fair range of temperate zone crops. Wheat and potatoes have been introduced into native cultivation in the Matengo Highlands. The native tribes of Songea are for the most part energetic farmers, particularly the Wamatengo. It is unfortunate that this area of great potential production should be so situated that export of any but high priced produce is uneconomic. At present all export produce is evacuated by expensive road transport, and it would appear that the only crops which can bear this heavy charge are tobacco and coffee. It is possible that the mineral resources of the district will be developed, in which case with an internal market mixed farming will become a profitable undertaking. For the present the policy is to improve the general standard of cultivation and where possible to introduce crop varieties superior to the local native strains. As before stated there are possibilities of producing tobacco for manufacture, but the margin of profit on which the development of this industry rests is a small one. The officers of the department are giving their attention to keeping up the quality of the tobacco and keeping down the costs of production. On both these lines of work, seed multiplication and demonstration, the native administration farms are very useful.

School Gardens.

23. The school gardens of most educational value are those attached to the Government schools. It is a difficult matter to overcome the tendency of missions to regard the school garden as a source of cheap food for the children. At the Native Administration school in Songea a high educational standard has been maintained and any tendency towards drudgery has been promptly checked by the Superintendent of Education and the District Agricultural Officer acting together. Through the co-operation of these two officers the mission schools are being brought into line and the value of their work increased. The Government school at Tunduru maintained a garden, planned by the District Agricultural Officer, Masasi, on similar lines to the Songea school garden. Through the agency of this officer the Benedictine Mission at Ndanda (Masasi), has established and maintained a very successful school garden with individual and communal plots.

24. During the year eight demonstration plots, or model native holdings, have been established in well populated areas. These plots are planned by the District Agricultural Officers and each plot is worked by a resident instructor. The plot is designed to embody the teachings of the department, and the instructor is held responsible for carrying out the work himself. This is a definite departure in method of instruction, occular demonstration taking the place of oral teaching. Should these plots prove of real value the number will be greatly increased.

General.

25. *Soil erosion.*—Demonstrations of contour ridging have been carried out in Mikindani, Lindi, Masasi, Tunduru and Songea. A notable demonstration was carried out by the District Agricultural Officer, Masasi, in

co-operation with the U.M.C.A. Mission at Chidya where erosion has been very severe. About twenty-five acres of land have been contour terraced and protected by storm drains.

26. *Tunduru rehabilitation.*—The year has seen a very great improvement in the food position in Tunduru. The planting of cassava and sweet potatoes has been carried out systematically throughout the district, and has been made the subject of an order under the Native Authority Ordinance. The cultivation of crops during the dry season in the wet valley lands has been actively encouraged with good results.

27. *Marketing.*—During the season a serious situation developed owing to the inability or unwillingness of small traders to purchase native produce for cash, with an almost complete reversion to barter. This restriction in the circulation of currency has had far reaching effects. As the whole question of marketing is at present *sub judice* no further comments are made here.

28. Looking back over the year it is apparent that it has been a year of generally increased production. Such fluctuations as are recorded are mainly the result of climatic conditions and the reaction of producers to depressed prices. In their endeavour to lower the cost of production, the sisal producers have increased their output—in some cases at the sacrifice of normal replanting. Natives have increased the proportion of those crops which they can themselves utilize. With the fall in prices of all forms of produce there is an obvious and serious tendency for a partial reversion to traditional subsistence farming. All officers have been engaged in an active campaign to check this tendency and to increase the export produce of the Circle in the present season. The results of this campaign will only be fully apparent at the end of this year.

29. Apart from the general work of instruction, the value of which it is almost impossible to assess, certain definite advances in native agriculture have been made :—

(1) The three tribal farms and the experimental station have supplied large quantities of good seed to their areas ;
(2) Two additional farms have been established for the same purpose ;
(3) Eight instructors' demonstration plots have been started ;
(4) There have been numerous demonstrations of contour ridging ;
(5) Three school gardens have been completely reorganized and established on sound educational lines, and others have been maintained ;
(6) The coconut plantations of the coast have been brought into a more healthy condition ;
(7) A vast improvement in the food situation in Tunduru District has been achieved ;
(8) The new tobacco industry of Songea has been taken out of the mire of Government subsidy and put upon a hard economic basis ;
(9) A start has been made with a similar tobacco industry in Masasi and Tunduru.

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i/c South-Eastern Circle.

ANNEXURE IV.

REPORT OF THE ENTOMOLOGIST
1931.

1. *Routine.*—2,917 miles were travelled by motor transport, 166 miles by rail; 40 miles foot safari making a total of 3,123 miles travelled in all. The number of nights absent from the station on duty was 97 (79 from July to December, or 43 per cent.). 1,103 inward items of correspondence were received and 970 items despatched making a total of 2,073 items dealt with.

2. *Equipment.*—A motor laboratory (Albion, type LB 41) to the design of the Entomologist was received into service in April. The interior working space of the laboratory is 10 feet by 6 feet by 6 feet. The equipment as to lighting, water supply, ventilation, insect-proofness, etc., is such as will during periods of entomological enquiry in the field ensure the safety and comfort of workers and provide convenience for microscopic work and general routine.

Separation from the library and facilities of the Morogoro entomological headquarters has proved at times decidedly inconvenient and irksome but, withal, residence in the Northern Province has permitted of a closer and appreciated intercourse with coffee interests than has been possible in the past. For adequate pursuit of pest enquiry, however, facilities at Moshi must be improved.

3. *Extension Work.*—Demonstrations featuring coffee pests and treatment have been given in Meru and Kilimanjaro. These have been illustrated with pest specimens and examples of their work and the chemicals and apparatus requisite for control. Attendances at demonstrations have been fully representative and work in pest control has thereby been activated. Meetings of the various planters' associations have been attended and seasonable pest work discussed. The press has accorded adequate notice of these activities and such publicity has been a means of dissemination of information to our other coffee districts. The response to these departmental activities must in these hard times be characterized as gratifying and, in this response, the recent improvement in coffee prices has also lent due assistance.

4. *Coffee Pests.* Leaf-miner (*Leucoptera coffeella*, Guer.).—The following internal parasites have been reared: *Elasmus* sp.n., *Eulophus* sp., *Atoposoma varicgatum*, Masi, var. *afra*, Silv. and *Pleurotropis* sp.n. High incidence of miner comes in waves, doubtless associated with weather phases inimical to the native parasites. The worst incidence of miner observed has been in districts of high prevailing winds, both high plateau and hillside. It is considered that under such exposed conditions, provision of adequate shelter belts would permit of the more efficient functioning of the parasites. The Institute of Entomology has suggested that the introduction of certain tropical American parasites of the pest might be considered.

5. Green Scale (*Lecanium viride*, Green).—The following internal parasites have been reared: *Coccophagus pulvinariæ*, Comp. (MS), *C. nubes*,

Comp., and *Tetrastichus gravans*, Silv. Of these, *C. pulvinariæ* is the major insect control: the effect of dry weather on incidence is suggestive that entomophagous fungi are an important controlling factor. Banding trees in chronic green scale areas and reliance on biological control is recommended rather than adoption of oil or lime sulphur sprays.

6. The Woolly Mealy-bug (*Pseudococcus perniciosus*, Newst. & Willc.).—This bug has been of general occurrence throughout the area but has never got out of hand. The following internal parasites have been reared: *Anagyrus aurantifrons*, Comp., *Achrysophagus* sp. (? *dactylopii*, How. or sp.n.), *Prochiloneuros* sp.n.(?). Of these, the major control is *Anagyrus aurantifrons*, Comp. Biological control may be safely relied upon.

7. The Coffee Bug (*Antestia lineaticollis*, St.).—Investigation has shown that the egg parasites *Microphanurus truncativentris*, Dodd, and *Hadronotus antestiæ*, Dodd, are universally present but alone effect a control which permits of too great a depreciation of crop.

Attention has been given to the physics and chemistry of the arsenite-sugar bait (*vide* former reports) and the following recommendations as a result of cage and field experiments are made:—

(i) The bait applied with an atomiser providing an upwardly directed fine mist (e.g. as with the Vermorel "Fog") need cause no economic damage;

(ii) The minimum per tree dosage should be one fluid ounce;

(iii) The standard formula:
60 grammes arsenite of soda (80 per cent. arsenious oxide and high solubility (*vide* Annual Report, 1929-30, Part II, page 39);
5 lbs. sukari guru (jaggery);
1 debe (4 gallons) water;

(iv) A course of spraying should consist of three rounds of the plantation at a week's interval to account for larval bug from egg hatching subsequent to the first spraying;

(v) The season for most effective spraying in the Northern Province is December to early April when coffee cherry is absent in the plantations or is in a green non-saccharine condition;

(vi) 1½ lbs. arsenite should suffice per acre full bearing coffee per annum;

(vii) Antestia control by this method should cost from five to six shillings per acre per annum.

8. Pyrethrum preparations have been under trial and the following are the conclusions drawn:—

(i) Pyrethrum powder × kerosene dococtions and pyrethrum extracts miscible with kerosene give an independable result in the windy conditions prevalent in our Northern Province; tree and ground spraying are requisite for a 50 to 60 per cent. kill and in areas of heavy leaf cast from thrips and/or hemileia fallen antestia are liable to be sheltered from the ground spray; the cumulative effect of the large dosages of kerosene requisite for antestia upon coffee is liable under tropical conditions to be injurious.

(ii) Water miscible proprietaries at 1 to 500 are safe and can give a 100 per cent. kill but results are variable with varying atmospheric conditions. The addition of soap may stabilize the lethal qualities of

such preparations. A combined antestia and thrips spray applicable in the December to April period may be the outcome.

(iii) Carrier × pyrethrum extract powders (not ground flowers) gives a 100 per cent. kill but the physical properties of the powders require improvement. The loss of covering power from pelletting of the powders is unsatisfactorily high. Improvement of hand and power dusters to manipulate such powders is also under study in conjunction with manufacturers.

9. *Pyrethrum cinerariæfolium* (the source of pyrethrum powder) for which Morogoro conditions initially proved too hot and dry has been successfully established (November, 1931) at Loliondo, Usa District. The seed was received from the Pathological Laboratory, Ministry of Agriculture, Harpenden.

10. A commercial Derris preparation under trial gave a kill varying between 40 and 70 per cent. The question of stabilization of results is under discussion with the manufacturers.

11. Coffee Thrips.—*Physothrips xanthoceros*, Hood, continues to be enormously destructive. In the period between the cessation of the masika rains and the onset of the short rains, temperatures throughout the coffee areas were above average and September to November rainless with a consequent onset of thrips necessitating field control at the period earlier than usual. In the similar period the red thrips, *Retithrips ægyptiacus*, March, became unduly prevalent but was ultimately wiped out by an internal parasite. While a continual urge is made for cultural methods of control (*vide* Entomological Leaflet No. 2), meanwhile adequate measures must be taken for chemical control of the pest. The following recommendations are made as a result of recent field trials :—

(i) Anti-thrips Spray :

Lime sulphur 1 to 60,

or

Lime sulphur 1 to 80 with calcium caseinate 1 lb. and nicotine sulphate 40 per cent., half pint per 100 gallons diluted lime sulphur.

The use of caseinate prevents the blob result obtained when lime sulphur is used alone and an even coating of both leaf and pest is effected.

(ii) Combined spray against hemileia and thrips ahead of the masika (February to March) :

Bordeaux mixture 1.1.10 plus 1 ounce nicotine sulphate 40 per cent. and 1 lb. whale oil soap.

Considerable emphasis has been given at meetings and demonstrations to the absolute necessity of maintenance of leafage by thorough control of thrips and hemileia. Partial but, in too frequent cases, considerable defoliation resulted every six months of the average coffee tree's life from these foliage enemies and a general debility predisposing to other pests like white borer too often resulted.

12. *Spraying General.*—

(i) It is essential if pest control expenditure is to be reflected in enhanced crop returns and improved produce quality that knapsack sprayers

should be absolutely discarded for thrips work and replaced by sprayers of the "Headland" type—manual or motor—working at not less than 150 to 200 pounds pressure. Such outfits would effect not only an economy but a satisfaction.

(ii) Forethought, organization and forcefulness in the conduct of pest control is on the average sadly lacking and very often not the labour (admittedly trying at times) but the brain power behind the labour is blameworthy.

(iii) Pest control is distinctly exacting work and planters must be more thorough and be more critical.

13. *Spray Preparation and Costs.*—Home preparation of lime sulphur (*vide* Entomological Leaflet No. 1) has, as a result of demonstrations, been almost universally adopted at a substantial saving to the industry. The cost per diluted gallon of spray on 1931 prices for raw material at Moshi was for home-made Cents 3 to Cents 3·2 inclusive of fuel, labour and white supervision as against for commercial Cents 5·95 to Cents 9·52. The per-acre cost for thrips control on these home-made lime sulphur costs and using a "Headland" type of pump varied from Shs. 9/- to Shs. 11/- per acre per application according to standard of efficiency and is inclusive of labour, material and pump rental.

14. Territory manufacture of lime sulphur was commenced in Arusha by private enterprise at Shs. 1/50 per gallon (28° Beaumé).

15. To date, reliance has had to be placed upon quick lime imported from Europe (price at Moshi and Arusha Shs. 380/- per ton). Study of local limes has been under way and our work has met with the ready co-operation of local producers. The chemical staff of Amani have afforded ready assistance with comparative analyses of various samples. Local limes have shown a content of free lime varying between 50 and 80 per cent. There were high contents of iron oxide and other insoluble residues. These latter led to a heavy and unmanageable sludge in large scale insecticide manufacture. Provided a suitable local lime can be forthcoming, a welcome saving of approximately £12 per ton at Moshi will be effected.

16. *Miscellaneous Notes:—*

The maize leaf-folder, *Marasmia trapezalis*, Guen., effected patchy destruction of maize of the main crop.

The maize stem-borer, *Busseola fusca*, Fuller, showed an interesting parasitism by *Chasmias glaucopterus*, Morl., while the maize diatræa borer, *D. argyrolepida*, Hmpsn., was attacked by two species of Syzeuctus.

The Diamond Back Moth, *Plutella maculipennis*, Curt., has proved a scourge on cruciferous crops. No parasitism has so far been observed.

The purple scale of citrus, *Lepidosaphes beckii*, Newm., is being satisfactorily controlled in Upper Usa by the fungi *Nectria tuberculariæ*, Petch, *Podnectria coccicola*, Petch, and *Myriangium duriæi*, Mont. and Berk.

The coffee leaf Hispid (*vide* Annual Report, 1927-28, page 37) has been determined as *Dactylispa hirsuta*, Gerst. Recently, it has not appeared in destructive numbers.

The clean bill of health as to Stephanoderes of our northern arabica coffee area is maintained.

Archibald H. Ritchie,
Entomologist.

ANNEXURE V.

REPORT OF THE ASSISTANT ENTOMOLOGIST.

1. *Staff.*—The Assistant Entomologist has been on duty throughout the year.

2. *Touring.*—The following localities have been visited during the year :— Mwanza, Shinyanga, Nzega, Ukerewe Island, Tabora, Bukoba, Iringa, Dabaga, Mufindi, Mbeya, Mbosi, Tukuyu, Kilosa, Kimamba. 135 nights have been spent on tour. 3,236 miles have been travelled by car and lorry and 450 miles by aeroplane on Government service.

3. *Correspondence.*—Inward 578, outward 332.

4. *Publications.*—Entomological Leaflets No. 10 "Beeswax" and No. 12 "Rats and Mice" have been issued. A bulletin on the Migratory Locust is in the press.

5. *Visitors.*—Among the visitors to the laboratory during the year were His Excellency the Governor ; Mr. Nowell, Director of Amani ; Mr. Milligan, of the Empire Cotton Growing Corporation ; Mr. Hornby, Acting Director of Veterinary Services.

6. *Tea Pests.*—The following insects were recorded during a tour of the tea-growing areas of Mufindi and Tukuyu :—

Mosquito bug *Helopeltis bergrothi*, Reut., Capsidæ.
Stilt bug *Miperus jaculas*, Thnbg., Coreidæ.
Stilt bug *Leptocorisa apicalis*, West, Coreidæ.
Aphis *Toxoptera aurantii*, Boyer, Aphididæ.
Thrips, unidentified Thripidæ.
Scale, close to *Selenaspidus* sp., Coccidæ.
Leaf Caterpillar *Acræa insignis*, Dist., Nymphalidæ.
Leaf Weevils *Dicasticus* spp., Curculionidæ.
Leaf Weevils *Systates* spp., Curculionidæ.
Leaf Beetle *Camenta* sp., Melolonthidæ.
Grasshopper *Eupropacris uniformis*, Ramme, Acrididæ.
Long-horned Grasshopper *Phaneroptera nana*, Charp., Tettigonidæ.
Leaf Miner, unidentified, Diptera.
Cutworms, unidentified, Noctuidæ.
White Grubs, unidentified, Rutellidæ.

None of these insects were particularly serious. Mosquito bug was general throughout Tukuyu, causing brown spotting of the leaves of nursery plants and larger bushes. Thrips and scale were negligible. Aphis was found mainly in nurseries and predatory Coccinelid and Chrysopid grubs were numerous. The leaf miner fly was found only in Mufindi and the degree of parasitism was very high. Caterpillars of the Nymphalid butterfly *Acræa insignis* were common in Mufindi. They are red and yellow with black spines

and so conspicuous that control by hand picking should not be difficult. Weevils of the genera Dicasticus and Systates were generally distributed, though serious injury was only found on young plants which had been heavily shaded during the dry season. The grasshopper *Eupropacris uniformis* was found in Dabaga, where a particularly localized but heavy infestation took place during the dry season (see under "Coffee Pests"). Long-horned grasshoppers were found making tubes of curled leaves on tea bushes, but no serious injury was noted. White grubs were recorded from one nursery only (see under "Coffee Pests").

The tea industry is as yet in its infancy and with the exception of a small area at Tukuyu, the plantations are still in process of being planted up.

7. *Coffee Pests.*—Coffee has been examined during the year in Bukoba and in the Southern Highlands. In addition to the coffee pests already recorded, the following were noted :—

i. The Tailed Coffee Caterpillar, *Metadrepana* sp., was found well distributed throughout Bukoba, feeding on coffee leaves. The fully grown caterpillar is brownish-green in colour, from 30 to 35 mm. in length with a projecting "tail" of 6 to 7 mm. The forepart of the body is swollen into a hump. The adult moth is drab to brownish with a wing span of 40 to 50 mm. The eggs are lozenge-shaped and deposited on the under surface of the leaves in columns up to 7 mm. high.

ii. A Lace Bug, *Habrochila placida*, Horv., was found in three localities in Bukoba. It was later found at Tukuyu. In both areas it occurred on the under surface of coffee leaves in dense shade. Adults and young congregate in clusters, and by their feeding produce a silvering of the leaf surface similar to the effect of thrips. Adults are 4 mm. long, brown and shining with reticulated wings and reticulated processes on the thorax. The nymphs are small, pale yellow, and with slender projections on the body which secrete globules of liquid during feeding.

iii. A small Halticid beetle, *Jamesonia testacea*, Wse., was observed in Bukoba feeding on coffee foliage, producing a shot-hole effect.

In the Southern Highlands the major pests are those common in other parts of the Territory, i.e. Antestia (*A. lineaticollis*, Stal.); Thrips (*Physothrips xanthoceros*, Hood); Green Scale (*Lecanium viride*, Green); White Borer (*Anthores leuconotus*, Pasc.); Leaf Miner (*Leucoptera coffeella*, Guer.); Red Thrips (*Retithrips ægyptiacus*, March); and Yellow Borer (*Dirphya* sp.) are of less importance. An unidentified Psychid moth was noted attacking leaves in its larval (bagworm) stage. An unidentified caterpillar was boring into the tips of both Arabica and Robusta main shoots, causing die-back and multiple branching.

In the Dabaga District of Iringa an outbreak of the grasshopper *Eupropacris uniformis*, Ramme, caused considerable damage in a plantation of young coffee. This insect is said by the local native to occur in cycles among the native cultivations in the mountains of that area. It has recently been doing damage to native crops in Ukaguru, a mountainous area further to the north. The grasshopper in Dabaga appears to have originated in the rain forest which surrounds the affected plantation on three sides.

White Grubs as pests of seedlings and newly set out coffee plants are frequently reported. All the places visited so far have proved to be areas of high humus content such as valley bottoms, seasonal swamps or the sites of native cattle compounds. Draining and liming has been recommended in addition to bare fallowing before planting. Paradichlorobenzene has proved successful in protecting plants set out in a badly infested area. A teaspoonful of the coarse crystals was placed in each of three holes around each plant at a distance of eight inches from the stem.

8. *Cotton Pests.*—A Capsid, *Camptobrochis* sp., was found on cotton on Ukerewe Island, Lake Victoria. Among specimens of the Jassid, *Chlorita fascialis*, Jac., collected in the Mwanza area and sent to Professor Paoli, a new species of Chlorita is reported. White Fly (Aleurodidæ) was numerous throughout Mwanza. The Sphingid moth, *Hippotion celerio*, L., caused some damage to cotton at Shinyanga in the early part of the season, the larvæ defoliating young plants. The two Tettigonids *Phaneroptera nana*, Charp., and *Pœcilogramme striatifemur*, Karsch., and larvæ of the Nymphalid *Acræa insignis*, Dist., were observed eating cotton leaves in the Morogoro District.

The following Heniptera are recorded in addition to those already listed in previous reports :—

Dalsira costalis, Ger., Pentatomidæ.
Aeschrus inæqualis, Spin., Pentatomidæ.
Miperus jaculus, Thnbg., Coreidæ.
Cletus ochraceus, Sch., Coreidæ.
Graptostethus servus, F., Lygæidæ.

Boll examination in the Morogoro District during the season has given the following results :—

Month	Bolls, No. examined	Locules			Platyedra per 100 Loc.
		Sound per cent.	Bollworm damage per cent.	Stained per cent.	
June	300 ...	71·0 ...	10·0 ...	19·0 ...	4
July	400 ...	62·1 ...	10·2 ...	27·7 ...	3
August	1,200 ...	50·3 ...	25·4 ...	24·3 ...	10
September ...	2,000 ...	35·5 ...	39·9 ...	24·6 ...	22
October	2,000 ...	50·1 ...	24·5 ...	25·4 ...	15
November ...	2,000 ...	64·8 ...	11·4 ...	23·8 ...	5

Compared with 1930 it will be seen that the rise and fall of Pink Bollworm incidence has been much more regular and that the peak occurred two months earlier this year. This corresponds closely with the development of the crop which, in the absence of unusual bud and boll shedding, began to produce ripe bolls about the last week in July. *Platyedra* larvæ were found on buds in May, at which period Spiny Bollworm (*Earias* spp.) was also present.

Detailed observation of individual cotton plants on the experimental plots gave the following results : Of the total number of buds produced on the plants, an average of 21 per cent. were shed before reaching boll maturity due to insect injury, and 46 per cent. were shed before reaching boll maturity from disease or physiological causes. A further 4 per cent. matured but were a total loss due to insect attack. Pickable cotton was obtained from 20 per

cent. of the buds produced. Shedding was approximately equal as buds and bolls, and in each case half showed no trace of insect injury or disease.

Examination of shed material showed the following bollworms still present in the fallen buds and bolls :—

	Per cent.
Pink Bollworm	91·4
Spiny ,, ...	6·3
American ,, ...	2·0
Pyroderces ,, ...	0·3

Apion xanthostylum, Wagn., was considerably more in evidence than usual in the Morogoro District. Grubs were noted at the base of cotton stems in July, and in the following month stems were attacked at the nodes up to the greenest parts. Infestation showed two peaks, in August and October. Little damage was done, but the increase in numbers is likely to prove serious if attack begins earlier in the season of 1932.

A detailed examination of bolls was carried out in the Shinyanga District, as representative of the cotton grown in the Lake Victoria basin :—

Month	Bolls, No. examined	Locules			Earias per 100 Locs.
		Sound	Bollworm damage	Stained	
		Per cent.	Per cent.	Per cent.	
April	400	45·1	3·5	51·4	3
May	700	69·6	2·2	28·2	1
June	1,150	60·3	3·0	36·7	2
July	2,000	34·7	6·7	58·6	3
August... ...	500	33·9	5·5	60·6	2

In comparison with the figures for Morogoro as representative of the coastal cotton areas, it will be seen that in the lake basin *Earias* takes the place of *Platyedra* as the major bollworm but does not do so much injury to mature bolls. This is in keeping with the observed preference shown by *Earias* for buds and tender stems. Staining of the lint is much more serious in the lake basin.

9. *Food Crop Pests.*—Maize and millets in the Central and Eastern Provinces were damaged during February and March by caterpillars. The Army Worm, *Laphygma exempta*, Wlk., and an unidentified Sphingid, were numerous in Morogoro. Maize on the experiment station was protected to a great degree from Army Worm by dusting with sodium fluosilicate, and with calcium arsenate. Other plots were protected by grass sprinkled with sodium arsenite being placed between the rows. The experiment was not on a scale sufficiently large to compare the different treatments.

Sodium fluosilicate was found to injure beans when applied against the beetle *Ootheca bennigseni*, Weis. Late planting appears to be the most economic method of dealing with this beetle.

Pyrethrum sprays were effective against the Turnip Sawfly *Athalia sjœstedti*, Kon.

The weevil *Gyponychus* sp. was reported from the south-east, attacking the leaves of legumes.

The Cossid, *Xyleutes capensis*, Wlk., was reared from larvæ boring castor stems. These larvæ have several times been sent by coffee planters who have suspected castor of harbouring grubs of the White borer, *Anthores leuconotus*.

10. *Locusts.*—The Migratory Locust, *Locusta migratoria migratorioides*, R. & F., invaded the Territory during February and March in the north-west. Oviposition took place as far south as 4° Lat. and east to 34° Long., most of the young swarms flew north or west during May and June, a few went south into Rhodesia, and others remained in the Territory.

A further invasion from the north began in November, over the whole border from Bukoba to the sea. Oviposition is anticipated over the greater part of the Territory.

Observations made in the field during March and April and on cage-reared specimens at the laboratory are incorporated in a bulletin to be issued shortly.

The following insects predatory on hoppers are recorded :—

Anthia artemis, Gerst., Carabidæ.
A. æquilatera, Klug., Carabidæ.
A. striatopunctata, Sacr., Carabidæ.
Piezia 5-signata, Frm., Carabidæ.
Macropoda nigrogemmata, Fr., Tenebrionidæ.
M. platynotus, Gerst., Tenebrionidæ.
Sepidium mucosum, Gerst., Tenebrionidæ.
Vieta lacunosa, Frm., Tenebrionidæ.
Distretus variabilia, Geb., Tenebrionidæ.
Phantasis sp., Lamiidæ.
Camponotus sp., Formicidæ.
Messor barbarus, L., Formicidæ.

Adult locusts were found infested with red mites and a parasitic worm *Mermis* sp.

A tracheal mite, apparently one of the Tarsonemidæ was located in the respiratory system of adult locusts. Blocking of the finer tracheæ was noted. Adult mites were found on the outside of the thoracic spiracles, so infection by contact is likely.

11. *Nematodes.*—Root infesting nematodes, provisionally referred to *Heterodera radicicola*, Greef., have been recorded during the year in the following hosts :—

Morus alba	Mulberry.
Coffea arabica	Coffee.
Nicotiana tabacum	Tobacco.
Lycopersicum esculentum	Tomato.
Petroselinum salivum	Parsley.
Brassica oleracea capita	Cabbage.
Dacus carota	Carrots.
Beta vulgaris	Beetroot.
Brassica rapa	Turnip.
Tropæolum majus	Nasturtium.
Phaseolus lunatus	Madagascar Bean.

12. *Apiculture.*—In spite of the general economic depression prevailing throughout the year the export of beeswax from the Territory reached the record figure of 12,143 cwts. Owing to the continued fall in price the total value was not a record but compares very favourably with all the post-war years except 1927 and 1928, as shown below :—

Year	Export Cwts.	Value £	Average per cwt. Shs.
1913 ...	11,180 ...	70,743 ...	126
1923 ...	6,039 ...	24,758 ...	82
1924 ...	8,497 ...	44,666 ...	106
1925 ...	5,858 ...	42,755 ...	146
1926 ...	6,147 ...	48,179 ...	156
1927 ...	11,169 ...	80,863 ...	144
1928 ...	9,815 ...	71,079 ...	144
1929 ...	6,721 ...	48,149 ...	144
1930 ...	3,773 ...	20,297 ...	108
1931 ...	12,143 ...	47,010 ...	76

Dar es Salaam exported 87 per cent. and Lindi 12 per cent. of the total.

Climatic conditions throughout the Territory have been favourable for bees from the time of the first honey flow towards the end of 1930. Reports of exceptional swarming activities were general during the early part of 1931. On the Morogoro Experiment Station ten hives were erected during one week and each was occupied within twenty-four hours. In one case a hive lay for ten minutes at the foot of a tree while a ladder was being brought, during which time a vigorous swarm took possession. Bees appear to have had no difficulty in making up immediately for the loss in numbers caused by the two unfavourable seasons of 1929 and 1930.

Extension work was carried out mainly by a native instructor who was on loan to the Native Authority of the Kahama District, Tabora Province, from December 1930 to November 1931. This district is one of the most important wax producing areas of the Territory. The instructor was mainly employed in the Ushirombo sleeping sickness zone. He visited all the sub-chiefs of the Sultanates of Ushirombo and Mbogwe, and made demonstration hives of the queen excluder pattern. He made over five hundred hives, and the interest of the native would appear to have been caught. Later he was able to demonstrate the value of the hive when the time for wax and honey collection came. The preparation of wax on the lines suggested in Entomological Circular No. 10 was demonstrated on all possible occasions.

13. *Rodents.*—Cotton fields in the Kilosa District were damaged by the grey field mouse. The western part of the Morogoro District also suffered, but to a less extent. The grey field mouse is a normal inhabitant of cultivated areas in the plains of the Eastern Province, and increases annually in early June at the time of the sorghum harvest. After this it turns its attention to whatever food is available and about September and October becomes numerous in dwellings, searching for stored foodstuffs. There is then a rapid decline in numbers. This cycle has been augmented with increasing force since 1928 in the Kilosa District by an influx from the surrounding bush.

During 1931 the influx was very marked. At Kimamba, where a large continuous area is under cultivation by Europeans, as soon as the sorghum was harvested, the mice attacked ripe cotton bolls and ate up the seed, much lint being soiled and rendered unginable. No abnormal increase of the other rodents of the province has been found. The source of the invading field mice has not yet been determined. As opportunity offers, the biology of the rodent population of the cultivated areas of the Eastern Province is being studied.

W. Victor Harris,
Assistant Entomologist.

ANNEXURE VI.

REPORT OF THE MYCOLOGIST.

The Mycologist returned from vacation leave on 14th April, 1931. The period of leave had been devoted to the study of subjects of direct importance to the work of the laboratory. In November mycological work was transferred to a more suitable building.

The herbarium and exhibit of specimens of crop diseases has been considerably enlarged, and has proved of value to officers of the department. By courtesy of the Mycologist in Southern Rhodesia authentic material of many tobacco diseases has been added to the herbarium. The Director of the Imperial Mycological Institute, Kew, has provided a variety of material of the major crop diseases not yet known in East Africa. A small exhibit of interest to coffee planters has been established at Moshi, under the care of the Senior Agricultural Officer. It is proposed to deal with the chief crops of other circles and districts similarly, as time permits.

Of value to the agricultural industry is the establishment by firms in Dar es Salaam and elsewhere of agencies for the sale of well known proprietory fungicides; this will considerably expedite the delivery of such chemicals when required by planters.

During the eight months of the year, 191 letters and a considerable number of packages have been despatched; 402 items of inward correspondence have been dealt with.

Eight visits have been made to plantations near the Central Railway in connection with the study of particular problems.

A typescript has been prepared for publication, entitled "A List of Fungi or Diseases on Economic Plants in Tanganyika Territory." This list catalogues the records made from the end of the war to May, 1930, and enumerates 141 fungi or diseases. Two leaflets have been added to the mycological series: No. 10 dealing with "Bordeaux Mixture and Some Other Fungicides", and No. 11 on "The Smuts of Sorghums and Their Control".

Field and Laboratory Experiments.

The experiments on the banding disease of sisal required to be recommenced for a third time, owing to inability to give them personal attention. Field and laboratory experiments have been initiated in connection with the rotting disease of sisal described below. Arrangements have been made for the demonstration by Agricultural Officers on the use of fungicides in the control of the grain and loose smuts of sorghum, which annually destroy a considerable proportion of the crop. The steeping of sorghum seed in copper sulphate or formalin solutions has been found to cause some delay in germination, but if conditions are favourable there should be little loss of seed. With the two per cent. concentration of copper sulphate which is advised, 89 per cent. of seed had germinated after eight days (100 per cent. in the

case of untreated seed). After sixteen days from sowing 96 per cent. of the treated seed had germinated. With the ½ per cent. formalin treatment also advised 87 per cent. of treated seed germinated during the first eight days, and 98 per cent. by the sixteenth day. If there is a risk of the upper layer of soil drying before germination, it is advised to sow ten per cent. more seed, using a corresponding increase in the amount of fungicide.

Diseases of Sisal.

No further occurrence of the banding disease has been recorded in the Territory, but what appears to be the same trouble is reported in the Belgian Congo, where it is associated with deficiency of nitrate, phosphates and potash in the soil. It is liable to occur in light soils.

A Rot of Sisal.—During 1931 a rot of sisal plants came under observation. The progress of this trouble differs from that of any other recorded disease of this crop. The rot starts in plants at leaf-stumps where leaves have been cut off during the wet season. Affected plants are recognized by their yellow colour and by the fact that the upper part of the plant can be readily pushed over, exposing the black rotten interior of the main stump. An infection of five per cent. has been found in one block of four hectares. Roots and suckers remain healthy. The cause is not yet defined, but there are indications that, like a number of other troubles in sisal, it is due to deficiency of some plant food in the soil, which renders the plants susceptible to the invasion of weak parasites and later of many saprophytic organisms. The subject is being investigated.

A Disease of Sisal Transplants.—A trouble of young plants simulating that just described has also been observed. In this case all the evidence points to the collapse and rotting of such young plants being due to water deficiency or injury at the time of planting out. This has been brought about by planting out too large suckers, to planting in the dry season, and to excessive injury in those suckers which have been taken from a parent rhizome. Field experiments at the latter end of the dry season showed that at that time of year the most easily established planting material is bulbils or young suckers: 48 among 50 bulbils were successfully established on the same ground where this disease and the previous one had appeared. Among small suckers from a nursery 118 in 120 became established on the same plot. Large suckers taken directly from parent plants and planted out were a failure: where the base was cut away only four in thirty-six grew well, and in the cases where the roots were left on and injury was small, fifteen in twenty grew. All the plants which failed in these experiments died down in the same manner that the young plants first observed had done. This indicates the distinction of this trouble from the rot in the larger plants.

With the doubtful exception of the rotting disease of sisal, it can be stated, with some assurance, that the diseases of this crop are primarily physiological, and depend on relationships of soil-food materials, water, heat and light to the growth of the plant. Without further comment it can be stated that there are about twelve such physiological troubles known in the Territory; information on these is being accumulated.

Diseases of Tea.

In addition to the two diseases of tea previously recorded (*Colletotrichum Camelliæ*, Massee, causing scabbed leaves, and *Armillaria mellea*, Vahl., causing a root disease, both in the Usambara Mountains) there are now a few more records. Grey Blight on leaves of tea in the Usambara Mountains is due to a fungus agreeing sufficiently closely with *Pestalozzia Theæ*, Sawada. A canker and ultimate die-back of the twigs of tea occurs at Tukuyu. A less abundant fungus on dead tea twigs at Tukuyu is *Stilbella Theæ*, Bernard. Leaves of tea from Mufindi showed a sun-scorching effect; a *Mycosphærella* sp. was present also on leaf spots, but is considered to be secondary. Seedling diseases are fairly common: *Rhizoctonia bataticola* was twice found to be the cause of a root disease. The same fungus was also found on roots of *Cassia floribunda* growing as a shade tree among tea. A serious disease, believed to be physiological in origin and agreeing closely with a disease recorded in Nyasaland, has been observed in the Iringa Province.

Diseases of Tobacco.

There are two common diseases of tobacco in this country. The first is White Mould (*Erisiphe cichoraceærum*, DC.), for which satisfactory control measures are known. This fungus has also been observed on wild Solanum species growing near tobacco at Moshi. The second disease is Frog-eye Spot (*Cercospora nicotianæ*, Ell. & Ev.). This has been found more frequently on native tobacco. The disease known as Crinkle, and believed to be due to a virus carried from plant to plant by insects, has been observed on a few native plantations in the Usambara Mountains and at Morogoro. It is recognized by the leaf veins being darker than the remainder of the leaf, and by the occurrence of leaflike outgrowths on the true leaves.

Diseases of Coffee.

A destructive root disease of coffee in the Usambara Mountains has been found to be caused by *Armillaria mellea*, Vahl. This would appear to be a different form from the Armillaria in *Grevillea robusta* previously recorded. Algal Spot (*Cephaleuros mycoidea*, Karst.) was found on the leaves of Liberian coffee at Bukoba; it is of little significance. The same fungus has also been found on the following plants: lime (*Citrus aurantifolia*), avocado (*Persea gratissima*) and guava (*Psidium Guajava*).

In addition to the fungus *Nematospora Coryli*, Pegl., which was found to be the cause of coffee bean disease in 1929, a second species which had been suspected all along has now been proved to be equally destructive. This species has been confirmed as *N. Gossypii*, A. & N. The two species will probably be found to be co-extensive. Among seven diseased coffee cherries from Moshi six contained both. *N. Coryli* as was expected has now been recorded from both Uganda and Kenya.

Diseases of Cereals.

Maize crops throughout the Territory suffer a varying but considerable amount of damage by fungi. This has been most noticeable as Ear Rots caused by *Gibberella moniliformis*, Winel., and *G. saubinetii* (Mont.), Sacc. Conidia of these fungi have been found associated with the characteristic

pink colour in scattered grains and in the upper parts of cobs respectively. Both of these fungi have been observed in their perithecial stages on old stalks and sheaths left in the fields. *G. saubinetii* was particularly abundant. Also on old stalks the following fungi have been found: *Diplodia macrospora*, Earle, and *D. Zeæ*, Lév., the former much more common than the latter. These two fungi are the causes of the *Diplodia* Rot of the ears, in this case associated with a white colour. At the nodes of growing maize the black spore dust of *Nigrospora sphærica* (Sacc.), Mason, is common. This fungus is also a potential parasite of the ears. A black dust seen at the nodes of old maize stalks is *Helminthosporium* sp., probably saprophytic. Endeavours are being made to reduce the losses of maize by means of field sanitation and other methods.

Of sorghum diseases there are no additional records to be made to those already listed in previous reports. The smuts however have come to be recognized as the cause of quite considerable loss. Grain smut (*Sphacelotheca Sorghi* (Link.), Clinton) is by far the commonest form. In the variety Bonganhilo at Singida as many as twenty per cent. of heads have been found affected. The percentage of grains destroyed in single heads averages sixty per cent. (20 to 90 per cent. in individual heads). With such infections there is a total loss of twelve per cent. of the crop. Such heavy loss is fortunately not general, but it is hoped to effect considerable improvement throughout the Territory, as a result of demonstrating the simple methods of seed treatment as recorded above.

Head smut (*Sorosporium reilianum* (Kühn), McAlp.) though equally widespread is kept under control as a result of the practice among natives of using it as food in the young state, i.e. before the spores have reached the ground.

Wheat at Iringa has been found with the orange leaf rust *Puccinia triticina*, Erikss. Barley in the same area was heavily infected with *Helminthosporium* sp.

Diseases of other Crops.

To the host plants of *Nematospora Coryli*, Pegl., in the Territory are added *Crotalaria striata* and black gram (*Phaseolus Mungo* L., var. *radiatus*).

Cape Gooseberry (*Physalis peruviana* L.) was severely attacked at Morogoro in July-August by the white smut fungus *Entyloma Physalidis* (K. & Cke.), Wint. The severity may have been partly seasonal, but as the majority of the leaves were yellowing and falling, all the affected leaves were collected and burned and the plants sprayed with weak Bordeaux mixture. The plants recovered and produced a normal crop.

Citrus seedlings at Biharamulo showed heavy damping-off by *Rhizoctonia bataticola*. In diseased Madagascar bean plants (*Ph. lunatus*) the same fungus and a *Diplodia* were present; they may have followed injury by eel-worms which were present. The former fungus was also found in Fiwi beans (*Dolichos lablab* L.) and apparently acting parasitically.

G. B. Wallace,
Mycologist.

ANNEXURE VII.

MOROGORO EXPERIMENTAL STATION REPORT.

Through the reorganization of the experimental area on the station during the early part of 1931 it was possible for much experimental work to be laid out on sound lines this year. Special attention has been given to the chief economic crops of the district in this way. The work has embraced the multiplication of strains of seed which have proved suitable to the climatic and soil conditions of the district, together with the introduction of other economics for trial, and the collection of varieties of certain native food crops, as yet not improved.

2. With the rearrangement of the layout of the station contour ridging was also extensively carried out. Between the experiment ranges long ridges were made and planted with *Vetiveria zizanoides* (Khus-khus grass) to bind them. On the more steeply sloping parts of the station contour ridges were laid out with the aid of an Abney level, with a result that certain bad rain erosion has been successfully stopped.

3. The 1931 season was marked by adequate and well distributed rainfall. The following are the monthly figures compared with 1930 and the average 1924 to 1929 :—

Month	mms.	1930	Average 1924-1929
January	55·0	171·4	80·8
February	115·4	164·6	85·3
March	191·7	273·4	130·9
April	249·1	151·9	159·4
May	172·2	52·1	51·7
June	19·1	1·6	23·4
July	0·0	3·9	8·6
August	6·6	1·7	11·5
September	23·6	7·6	29·6
October...	5·3	15·2	30·5
November	29·1	11·8	50·1
December	—	22·8	94·1
	Total ...	878·0	755·9

4. *Cotton Experiments.*—Two experiments and the multiplication of the U/4/4/2 strain from Barberton were undertaken. The manurial trial is referred to below (paragraph 11) and the multiplication in paragraph 12.

5. In the variety trial (full report to follow) seven strains of U/4 cotton from Barberton were tried against the local seed. Only small quantities of seed of the U/4 strain were available and the trial was laid out in four blocks, each block containing one line of each strain with the local as a control, arranged at random. No supplies were made and results were obtained from twenty randomized plants in each row.

6. Boll counts were made from time to time on three blocks, using ten plants per row. The figures of the last count on 8th July are given in table I:—

TABLE I.

Mean number of bolls per plant in U/4/4 strains, 8th July, 1931.

Strain	No. of plants	Mean No. of bolls per plant	Standard deviation
H/67	30 ...	49·67+4·65 ...	25·5+3·16
C/15	30 ...	47·50+4·75 ...	26·0+3·35
U/4/4/10	30 ...	45·00+4·67 ...	25·6+3·29
Z/14	30 ...	44·67+5·39 ...	29·5+3·80
Z/9	30 ...	44·00+4·19 ...	23·0+2·96
U/4/4/2	30 ...	42·30+4·83 ...	26·5+3·41
H/77	30 ...	29·00+3·74 ...	20·5+2·63
Morogoro	30 ...	23·15+2·83 ...	15·5+1·99

This shows the first six significantly superior in boll formation to H/77 and Morogoro.

7. Four pickings were made in order to harvest all the cotton formed. The figures were obtained from the harvest of twenty plants in each row, giving eighty plants as a sample for each strain. Results are given in table II:—

TABLE II.

Average yield per plant of U/4 strains of cotton, 1931.

Strain	No. of plants	Mean wt. of seed cotton per plant in units*	Standard deviation
U/4/4/10	80 ...	16·30+0·98 ...	8·80+0·70
C/15	80 ...	14·75+0·91 ...	8·18+0·65
Z/14	80 ...	13·68+0·86 ...	7·70+0·61
U/4/4/2	80 ...	12·80+0·67 ...	6·05+0·48
Z/9	80 ...	12·45+0·74 ...	6·60+0·52
H/67	80 ...	11·46+0·60 ...	5·38+0·43
Morogoro	80 ...	11·20+0·67 ...	6·03+0·48
H/77	80 ...	10·98+0·69 ...	6·18+0·49

From these figures for the 1930 conditions, U/4/4/10 and C/15 are significantly superior to the local cotton and H/67 and H/77, while U/4/4/10 itself is superior to Z/9 as well. Under Morogoro conditions—U/4/4/10 is a tall growing plant, with an open branching habit, the branches practically all sympodia, C/15 is a much shorter type and tends to throw rather more vegetative branches.

8. The percentage ginning outturns obtained with a Platts roller hand gin were as follows (on four samples each of twenty plants):—

*The unit is one-eighth ounce which was used to obtain a better scatter in the distribution table.

TABLE III.

Mean percentage ginning outturn of lint from U/4 strains, 1931.

Strain	Mean percentage lint	Standard deviation
U/4/4/2	39·65+0·29 ...	0·59 ±0·20
U/4/4/10	39·12+0·19 ...	0·38+0·13
Z/14	38·93+0·25 ...	0·51+0·18
C/15	38·58+0·35 ...	0·69+0·24
Z/9	38·15+0·13 ...	0·27+0·09
H/77	37·60+0·11 ...	0·22+0·08
H/67	37·48+0·05 ...	0·11+0·04
Morogoro	34·95+0·31 ...	0·62+0·22

On these figures all the strains are shown to give a better ginning outturn than the local cotton, while the two U/4/4 strains are significantly better than all except C/15.

9. This is the first year of these trials and the results can only apply to the conditions experienced in 1931. They will be continued in 1932 with the introduction of further strains, and after two or three years a reliable result will be obtained.

10. Samples of lint of each strain are being sent to Head Office for submission to the Imperial Institute for the comparison of lint qualities. The lint of the U/4 strains is on the whole of a good staple and silky, comparing well with the local No. I cotton.

11. *Cotton Manurial Trial.*—This trial was made with bone meal obtained from Messrs. Meat Rations, Ltd., Mwanza. The plots were laid out on the chessboard method with nine replications, alternate plots being treated with bone meal at the rate of two cwts. per acre. No significant results were obtained.

12. *Multiplication of* U/4/4/2.—Four and a half one-tenth acre plots were sown with seed of this from Barberton, for multiplication. 431 lbs. of seed cotton were harvested which is equivalent to 960 lbs. per acre.

13. The time of sowing experiments with cotton were discontinued this year as the series 1924-30 show conclusively that sowing should take place as soon as possible after the commencement of the big rains, in February. This optimum period is usually 15th February to 7th March.

14. *Sisal and Furcræa fibres.*—A comparative trial of sisal and Furcræa was planted up in February with the purpose of comparing the two plants for :—

(a) the period between planting and first cutting ;
(b) periods between cutting ;
(c) yield of fibre per acre ;
(d) number of cuttings before poling.

Both were well established but the Furcræa has shown very much more rapid growth and is now practically twice the size of the sisal. Six replications of the plots have been made on an adaptation of the half drill strip layout.

A manurial trial with sisal, using bone meal at the rate of two cwts. per acre has also been laid out, using the Faulkner strip method.

15. *Maize Manurial trial.*—A manurial trial similar to that laid out with cotton was also made with Potchefstroom Pearl maize. Again the results were negative, and the late application of the manure is felt to have been the cause. The experiment is to be repeated on the same plots in 1932 to see if there is any residual effect of the manure, while a further experiment with an earlier application is to be laid out. The figures for the 1931 trial are given in table IV :—

TABLE IV.

Mean yield of: (a) total produce, (b) grain.

From manured and unmanured plots of maize, 1931.

(*a*).

Treatment	No. of plots	Average weight of produce per plot (lbs.)	Standard deviation
Manured	9	106·33+3·34 ...	10·03+2·36
Unmanured	9	103·47+4·94 ...	14·83+3·50

(*b*).

Treatment	No. of plots	Average weight of grain per plot (lbs.)	Standard deviation
Manured	9	65·17+2·45 ...	7·34+1·73
Unmanured	9	65·03+2·05 ...	6·15+1·46

Absolutely no differences were discernible between the plots during the growing season.

16. *Russian varieties of maize.*—Eight small packets of varieties of Russian maize were received for trial with Potchefstroom Pearl and White Cango maize. Only short single lines could be planted due to the small quantity of seed and a severe attack of Army Worm completely ruined the experiment. From what was seen of the seed received and the few surviving plants these varieties are far inferior in type to that at present in use, and have a small yellow seed.

17. *Maize multiplication of seed.*—The yields for Potchefstroom Pearl and White Cango are shown in table V :—

TABLE V.

Yields of graded Potchefstroom Pearl and White Cango Maize, 1931.

Variety	Area acres	No. 1 lbs.	No. 2 lbs.	No. 3 lbs.	Yield per acre (lbs.)
Potchefstroom	6 ...	338 ...	3,229 ...	5,134 ...	1,450
White Cango	3 ...	166 ...	2,547 ...	1,795 ...	1,502

The yield of No. I maize or selected seed is very low indeed.

18. *Sorghums South Africa variety trial.*—Nine varieties of short term sorghums from South Africa were received for trial with Bonganhilo as a control. There were small quantities only and three replications of blocks of single lines of each variety, a line of Bonganhilo between each variety, were planted. The results are overwhelmingly in favour of Bonganhilo on the first year of introduction the best variation giving only one-seventh the yield

of Bonganhilo. The type of plant is inferior and that it is considered doubtful whether further trials are justified. The figures are not given as they are considered a waste of space.

19. *Trichodesma*.—Reference is made to paragraph 11 of Part II of the Annual Report, 1930, for this station :—

> "The plant *Trichodesma zeylanicum* is a weed of cultivation widespread in the Morogoro and Kilosa Districts. It springs up naturally in native grain fields following harvest, and makes most of its growth during the dry season, often forming pure stands. Seed ripens continuously over a long period and the optimum season for harvest would appear to be from October to November . . . . . The value of the seed (as oil seed) was then (1926) estimated at £9 10s. per ton."

Experiments were laid out this year to investigate the following :—

(a) methods of sowing and harvesting ;
(b) methods of threshing ;
(c) time of sowing.

A chessboard layout was used in (a), latin square in (b) and quadruplicated random strips in (c).

The results have been disappointing and have shown the great difficulty in harvesting any large amount of seed through the unevenness of ripening on different parts of the plant. While most ripe seed seems to be on the plant during October and November, it is then most difficult to harvest due to the extremely brittle nature of the inflorescence stalks. It seems that it might be best to harvest at the end of September or early October with the flower heads green, the calyces drying out on the plant. It is hoped to experiment on this in 1932.

20. Figures are not given for these experiments as the number of indigenous plants which grew up in the plots and could not be checked, make the figures unreliable. But some general conclusions could be drawn. First in sowing, broadcasting or drilling the seed gives much the same result, and broadcasting would be probably more suitable as taking less time and labour. The optimum time of planting would seem to be early in April, when the plant normally begins to show in the field. In harvesting great loss occurred when the plant was cut and carried to the threshing floor. Pulling individual heads by running the hand up each branch gave much increased yields but not, on the figures obtained, significantly more than in cutting. Harvesting before the seed is dead ripe would have to be resorted to for economical harvest of the seed. The yield from two one-tenth acre plots left in the field, self sown, was only 5·5 lbs., or 55 lbs. per acre. That had very careful cutting and transport of the plants to the threshing floor. The best yield from one of the plots in the experiments was at the rate of 210 lbs. per acre, and that was pulled, not cut, from a broadcast plot.

21. In threshing of the three methods tried, beating the plants with sticks was quickest and most effective. Rubbing out with the hands was effective but slow, while beating small sheaves of the plants on bamboo rails, while effective necessitated two actions, the beating and then further beating with sticks, the seed not separating from the calyx by beating on the rack above.

22. *Kidney Bean Variety trial.*—A chessboard trial with one-fortieth acre plots, and six replications, of Canadian Wonder bean and the native "Maharage" was laid out. This could not be planted until 7th May due to leaf eating beetle attacks on the leguminous crops. Due to this and the ensuing dry conditions in June and July the yields were very poor and no significant superiority of the Canadian Wonder bean was obtained. Yields are given in table VI, and are equivalent to just over 60 lbs. per acre :—

TABLE VI.

(a)—*Yields of Canadian Wonder Bean and Native Kidney Bean trials; six one-fortieth acre plots in chessboard arrangement, 1931.*

Variety	No. of plots	Mean yield per plot (ozs.)	Standard deviation (ozs.)
Canadian Wonder Bean	6	24·46+4·9	12·14+3·5
Native Kidney Bean	6	25·38+5·7	14·01+4·0

(b)—*Bean weight on 100 beans.*

Variety	No of samples	Mean weight of 100 beans (ozs.)	Standard deviation (ozs.)
Canadian Wonder Bean	10	1·11+0·02	0·05+0·01
Native Kidney Bean	10	0·91+0·01	0·04+0·01

As seen from table VI (b) the Canadian Wonder bean is significantly superior to the native bean in size, and its uniformity is especially noticeable against the piebald native beans. It is considered that the Canadian Wonder bean suffered most from the dry conditions and that where it would be planted with early rains before the beetle damage is prevalent, it would be a better bean. Under irrigation it has continued to yield heavily and better than native beans.

23. *Soil Variation.*—An interesting test of soil variation in the area covered by the sisal—Furcraea trial was carried out using strips of buckwheat. Eight strips four feet wide were sown one between each of the discard rows of the plots, in drills six inches apart, each drill being carefully sown with two ounces of seed in an attempt to obtain as even a distribution as possible. Eight one-yard squares, well scattered were cut out of each row just as the buckwheat was flowering, and the produce weighed up. Later, when the plants were ready for harvest, eight further one-yard squares were taken from each row and the seed weighed. The two results were broadly similar, and showed the trend of fertility in the block.

24. *Collection of varieties of Bananas, Cassavas and Sweet Potatoes.*—Some one hundred named varieties of sweet potatoes and one hundred and fifty varieties of cassavas have been sent to the station from all areas of the Territory. These have been planted with a view to the selection of the better types. Some ten varieties of bananas, local and from other districts, have also been collected.

25. *Propagation of Citrus and other fruit trees.*—The Head Gardener has been stationed at Morogoro during the last two months of the year with a view to the propagation of the various fruit trees on the station, and the planting up of new citrus orchards. He has been budding the several types

of citrus fruits and grafting mangoes from good types now on the station. The Litchi is also being propagated and more guavas raised.

26. The few good trees in the coconut block were selected from the rest during the year and the latter marked ready for felling. Large and well shaped nuts were selected from the best trees for seed and a nursery established to provide plants to replace the worst trees which have been cut out.

27. *Investigations with plants.*—Seed of the indigenous *Indigofera endecaphylla* was sown in one area and proved a very efficient soil cover once it had become established. It is a completely procumbent plant and acts as a good smother of weed seedlings. Its power of growth through dry periods and of re-establishment are being noted. After the dry season it becomes very thin and straggly so that the rapidity of its recovery, if any, is important. Seed from Java of the same plant failed to germinate but Javanese seed of *Indigofera arrecta* grew well after a slow start. This would prove more of use as a green manure as it has an upright habit and hence little smother effect. It would also form an excellent contour ridge plant, as it can be ratooned and the toppings incorporated in the soil.

The Sunn Hemp, *Crotalaria Juncea*, was grown on the station this year and proved a quick growing and good cover, there being little or no weed growth under the crop when cut. Retting of bundles of the plants was tried, but with very disappointing results. The fibre did not come away well from the stems and seemed to rot during the retting. The plant was not well grown for fibre, being short and branched. This fact and that the plants may have been cut a little late for retting perhaps account for the poor results of retting.

28. In view of the losses of young economic plants from imported seed due to white ants and poor conditions of the nursery, a propagation shed has been built and should solve this problem.

29. Nursery beds of Heavy Western tobacco were sown in December for a fully costed trial of this tobacco on the station. Some five acres are to be grown during 1932.

Aleurites triloba, Candle nut.—The twelve seedlings in the Arboretum, planted in 1928, flowered well this year and set a considerable quantity of fruit, ready for harvest at the end of November.

Aleurites Fordii, Tung Oil.—Seedlings of this tree are being raised to plant out a one-acre block for investigation and as a source of seed supply. The Tung oil seedlings planted out on the station are making fair progress, but do not seem to go away well for some time after transplanting. Sowing at stake may be the most satisfactory method of planting this tree.

Hydnocarpus Anthelmintica and *H. Wightiana* are both continuing to grow well. The *H. Wightiana* has flowered and set fruit in December.

Caraboa mango.—Three seedlings were planted in the Arboretum and are growing successfully.

Carica papaya.—A block of pawpaws was established in order to investigate the possibilities of the economical extraction of papain on the station.

30. The following quantities of planting material were received for investigation, other than those dealt with in the annual crop experiments :—

Quantity introduced.					
Plants	Seed packets	Cuttings	Rhizomes	Suckers	No. of spp. represented
330	60	25 bundles	5 bundles	12 bundles	80

31. *Seed multiplication.*—The multiplication of seed of various crops was, as usual, carried out, and the yields are given in Appendix I. The quantities of seed distributed and revenue of the station are shown in Appendices II and III.

APPENDIX I.

YIELDS OF SEED MULTIPLICATION, MOROGORO EXPERIMENTAL STATION, 1931.

		Total yield	Yield per annum
CEREALS:			
Maize.	Potchefstroom Pearl	8,701 lbs.	... 1,450 lbs.
	White Cango	4,508 ,,	... 1,502 ,,
Millets.	Bonganhilo	1,295 ,,	... 1,295 ,,
	Sukesha	144 ,,	... 720 ,,
Pulses.	Black gram	55½ ,,	... 100 ,,
	Green gram	554 ,,	... 615 ,,
	Canadian Wonder ... ... (This was almost destroyed by beetle attack in March)	11 ,,	... — ,,
	Lima bean	16 ,,	... 160 ,,
	Chick pea	60 ,,	.. 600 ,,
OTHER FIELD CROPS:			
Cotton U/4/4/2:			
	Seed cotton	431 ,,	... 960 ,,
	Seed	293 ,,	... — ,,
	Buckwheat	147 ,,	... — ,,
	Crotolaria juncea	150 ,,	... — ,,
	Indigofera endecaphylla ...	20 ,,	... — ,,
	arrecta	14½ ,,	... — ,,

APPENDIX II.

DISTRIBUTION OF SEEDS FROM THE MOROGORO EXPERIMENTAL STATION, 1931.

CEREALS		
Maize.	Potchefstroom Pearl	5,104 lbs.
	White Cango	1,440 ,,
Millets.	Bonganhilo	297 ,,
	Sukesha	70 ,,
	Kilinyali	50 ,,
Pulses.	Green gram	12 ,,
	Black gram	10 ,,
	Cowpeas	440 ,,
	Tepary bean	86 ,,
	Canadian Wonder bean	6 ,,
	Maharage	2 ,,
	Chick peas	25 ,,
OTHER CROPS:		
	Buckwheat...	50 ,,
	Sunn hemp...	30 ,,
	Indigofera endecaphylla	4 ,,
Vegetable seeds.	... ...	5 pkts.
Fruit trees.	... ...	77 plts.
Decorative and economic plants.	... ...	107 ,,

APPENDIX III.

Distribution of Planting Material from the Morogoro Experimental Station, 1931.

	Quantity	Material
Gliricidia maculata	600	cuttings
Bananas (various)	12	suckers
Coffee	90	seedlings
Citrus (various)	807	plants
,, ...	1 (bundle) ...	budwood
Mulbery	45	cuttings
Grenadilla	14	plants
Cactus (spineless)	2 bags ...	cuttings
Wineberries	6	plants
Khus-Khus grass	2 bags ...	sets
Other fruit trees	68	plants
,, ...	12	suckers
Decorative plants	1044	plants
,, ...	49	cuttings
,, ...	4 bags ...	rhizomes

APPENDIX IV.

Revenue for Sale of Plant Material, Morogoro Experimental Station, 1931.

	Shs.	Cts.
January	128	04
February	17	65
March...	109	50
April	18	70
May	10	00
June	23	00
July	13	00
August	2	00
September	108	20
October	33	00
November	20	00
December	158	00
	641	09

N. R. Fuggles,
District Agricultural Officer.

ANNEXURE VIII.

TABORA-MWANZA EXPERIMENT STATION, IBADAKULI.

General.

The prime function of the experiment station at Ibadakuli is to afford a means of collecting data regarding the spacing, time of planting and behaviour of various crops which are normally cultivated by natives throughout the Tabora and Mwanza Provinces, and in addition to test the performance of new crops which might profitably be extended to native agriculture in these areas.

The population immediately served by the experiment station is entirely native and consequently the adoption of new practices which are recommended from time to time, as the outcome of our experiments, must necessarily be slow.

That they are to a certain extent being adopted is evidenced by the increasing number of plantations planted in straight lines, by the greater tendency for natives to plant pure crops as opposed to mixed crops and by the numerous requests from chiefs and the more intelligent cultivators for new and improved varieties of seed.

Methods of planting, etc., and implements used on the experiment station are such as can be used by all native cultivators without expense with the exception of ploughs which are always on sale at this office for a small sum.

Pests and Diseases.

The whole experimental area suffered considerably from continued depredations by adult locusts and this combined with ravages of white ants militated against a true conception of results as presented by the crops *in situ*.

The incidence of white ants was even greater than in past years. In every experiment replanting had to be done several times and the extent of the damage may be gauged when it is mentioned that a 95 per cent. stand of cotton was reduced to less than 40 per cent. in the space of ten days after the seed was planted.

Doubts were entertained that any data obtained would be valueless but as the attack was general throughout the farm the records given in the succeeding pages of this report can truthfully be said to give an accurate comparison of the behaviour of the various crops under extremely adverse conditions and therefore to avoid repetition, losses or variations caused by the above-mentioned factors will not be subsequently referred to in the presentation of results as they are all equally applicable.

Large numbers of the Spiny bollworm (*Earias insulana*) made their appearance in September, the end of the season, and consequently their effect was negligible.

The prevalence of smut (presumed *Sphacelotheca Sorghi*) on sorghums was general, the infection being estimated at 3 to 10 per cent.

Heavy localized aphid attack was observed on sorghums towards the end of the season, the soil round infested plants being blackened by the deluge of honey dew. The attack was almost entirely confined to sorghums and luckily did not spread to cotton. Damage done was of no account.

Losses occurred by rats eating the newly planted seeds, but the use of poisoned bait considerably reduced their numbers.

Meteorological.

The total precipitation of rain was good but the distribution was extremely unfavourable for plant growth. Abnormally heavy rains fell in limited periods followed by long spells of hot dry weather during which newly germinated plants wilted and died.

The lack of subsoil moisture is characteristic of the district and therefore continued showers spread over the early growing period are essential for good harvests.

The growing period was short on account of the almost complete cessation of the rains at the end of May. Hot dry winds of high velocity were frequent and on many occasions rendered operations impossible, clearly demonstrating the urgent need for extensive anti-æolian soil erosion measures.

Maintenance and Development.

A deep well was constructed and a hand pump installed near the office. An excellent and adequate water supply is now available for all purposes and serves a long felt need at Ibadakuli. A new rest house was built, labour lines repaired and the blacksmith's shop removed to more suitable premises.

Several deaths amongst the ploughing oxen were attributed to rinderpest. The herd was inoculated several times but in spite of this and the extreme drought experienced from April onwards, the oxen were well supplied with food in the form of maize ensilage and hay and their general appearance was good.

Experimental Lay-out.

A new departure in the lay-out of experiments was made during the year under review. Hitherto one-fortieth acre plots have been laid down in series and yields calculated according to the average production of the total number of plots. Also times of planting experiments and spacing have been conducted separately. This year yields have been calculated on the average production from measured rows whilst times of planting and spacing, being correlated, have been conducted together in complete series. The procedure adopted is then as follows :—

Time of Planting correlated with Spacing.

Complete series of all the spacings under trial with maize, cotton and groundnuts were planted whenever planting conditions were favourable but not at less than ten-day intervals. Three or four rows of each spacing were planted 480 feet long. The fourth row was planted wherever necessary to

give three rows of correct spacing. Dummy rows were planted to overcome "end row effect".

Before picking or harvesting 100, 200 or 480 feet lengths were staked out on each row. These lengths were chosen as representing the most characteristic behaviour of the rows under consideration and as they were rarely adjacent the method gave a fair amount of randomization. In addition, where possible the total yield of each complete row was noted and compared with the selected length to avoid undue distortion of results. In the final computation of results yields from equal lengths of rows only were compared and are given in the tables which follow.

The method, involving as it does a tremendous amount of separate weighings and calculations, is nevertheless considered the most practicable means of arriving at a correct presentation of the facts when such environmental factors as those previously mentioned under "Pests and Diseases" are prevailing. Yields per acre, then, have throughout been calculated on row yields with the exception of bulk crops of beans, sorghums and millets. In the following tables the figures given represent yield in pounds per acre :—

TABLE I. EXPERIMENTS WITH MAIZE. *Variety, White Cango.*

Time of Planting correlated with Spacing.

Spacings	11-12-30 lbs.	21-30 lbs.	4-1-31 lbs.	21-1-31 lbs.	25-2-31 lbs.	10-3-31 lbs.
3′ × 1′ ...	56	310	1,015	435	289	351
3′ × 2′ ...	107	331	1,160	362	169	298
3′ × 3′ ...	119	245	1,160	283	185	458
4′ × 1′ ...	99	306	1,199	175	61	364
4′ × 2′ ...	79	292	1,417	166	47	443

Previous experiments conducted at Ibadakuli over a number of years indicate the optimum time of planting for maize as being between the end of December and the first three weeks of January. The results are again in accordance with these findings but the importance of taking advantage of a good planting time during this critical period cannot be over emphasized, especially during an obviously abnormal season.

It would appear that the most suitable spacing is 4 feet by 2 feet. The higher inter-row spacings have invariably given greater yields.

TABLE II. EXPERIMENTS WITH GROUNDNUTS. (*Unshelled nuts*).

Time of Planting correlated with Spacing.

Spacing	21-12-30 lbs.	5-1-31 lbs.	22-1-31 lbs.	21-2-31 lbs.	9-3-31 lbs.	21-3-31 lbs.	3-4-31 lbs.	20-4-31 lbs.
12″× 6″ ...	2,858	2,497	1,249	960	556	163	15	19
12″×12″ ...	2,835	1,980	1,260	1,065	706	142	19	21
18″× 3″ ...	2,080	2,220	1,220	1,060	686	111	15	8
18″× 6″ ...	1,820	2,140	1,170	1,000	570	119	11	24
18″×12″ ...	2,080	1,920	1,260	870	584	105	18	18
24″× 3″ ...	1,541	2,194	1,185	945	594	101	19	16
24″× 6″ ...	1,935	1,920	1,248	915	558	70	16	4
30″× 3″ ...	1,503	1,836	1,134	855	531	82	14	10
30″× 6″ ...	1,215	1,578	1,044	774	528	120	16	11

From the foregoing table of results it would appear that early planting with the closer spacings is productive of the best yields.

It will be noted that with few exceptions, the more nearly the area allotted to each plant approximates to a square, the more productive the plant becomes. It suggests that the cause lies in the plant being able to form a perfect cover for the ground with a resultant checking of evaporation from the soil during a very dry season, such as the one under review.

The custom in the past has been to plant groundnuts 30 inches by 9 inches but it was felt that much closer spacings might give better results, therefore, in view of the results obtained above the trials are again being conducted at the Lubaga experiment station this season.

Experiments with Groundnuts.

Trials on Ridges and on the flat:

	Flat	Ridges
Virginia Bunch	1,089	887
Native	1,030	918

Table III. Experiments with Cotton.

Time of Planting correlated with Spacing.

Spacing	10-12-30	21-12-30	5-1-31	21-1-31	20-2-31	5-3-31	21-3-31	2-4-31	18-4-31
	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.
36″× 2″	849	559	662	214	142	142	172	178	178
36″× 6″	670	429	522	275	124	127	148	169	193
36″×12″	668	634	468	372	136	100	133	163	157
36″×18″	516	631	453	196	148	148	136	169	142
36″×24″	450	459	408	163	157	115	145	127	112
30″× 6″	536	492	449	268	116	177	193	163	120
30″×12″	511	421	584	231	144	152	127	187	155
30″×24″	511	378	596	326	72	156	148	174	196

Experiments conducted over a period of six years during which results have been identical to a degree, have definitely fixed the optimum time for planting cotton as the month of December or early January.

Not only are greater yields obtained but in addition the risk of bollworm attack is minimized as the peak of bollworm incidence occurs between the months of August and September.

It has been suggested that December planting of cotton may result in a carry-over of bollworm from the previous season but so far our observations point to the contrary.

The increased yields of the closer spacings are interesting. This is the first year that trials with such close spacings have been carried out and therefore it is too early to form a definite opinion as to their suitability or otherwise but it is reasonable to state that even if plants spaced at two inches apart produce one good boll each only, the yield per acre will be far greater than that obtained from plants which yield only five good bolls when spaced at 18 inches apart and curious as it may appear, in many cases the average number of bolls per plant in many native plantations is well under

five. A spacing of 2 inches by 36 inches is only possible under experimental conditions but we may find that continuous line planting may be conducive to greater yields than line spacing.

In view of the prominence which is now being given to the broadcast sowing of cotton seed for the subsequent production of cellulose for artificial silk making the figures have added interest.

Cotton Ratooning Experiment.

Ratooned	First flower	Boll bursting	Yield per acre.
5.11.30 ...	3.1.31 ...	22.2.31 ...	433 lbs

The quality of the seed cotton produced was extremely poor.

Barberton Selections.

	Yield per acre, lbs.
H.67	577
Z.14	474
U4/4/10	466
Z.9.	459
Cambodia	437
C.15	414
H.77	394

The above selections were received from the Empire Cotton Growing Corporation Research Station, Barberton, South Africa. Each type was "selfed" and the progeny will be planted in progeny rows at the experiment station, Lubaga.

Double Strip Experiment.

Trial with Webber cotton against District cotton.

Let A represent District cotton and B Webber cotton, the layout was therefore in equal length rows as follows:—

A B B A A B B A A B B A

Yield Webber cotton, ozs.	Yield district cotton, ozs.
21	67
28	71
19	73
23	61
20	73
15	38
11	32
11	54
23	87
12	63
22	44
13	27

The greater yielding capacity of district cotton is obvious and requires no further explanation.

Variety Trials—Legumes.

	Yield per acre, lbs.
Mat beans	905
Buffalo beans	606
White Hopi beans	528
Cowpeas	440
Lima beans	124
Black Gram	18
Fiwi beans (white)...	10
Fiwi beans (black)...	4
Madagascar butter beans ...	Failed
Canadian Wonder beans	,,
Tepary beans	,,

Variety Trials—Millets and Sorghums.

	Yield per acre. lbs.
Bonghanilo	1,070
Kilinyali	808
Panicum frumentaceum... ...	742
Red Amber	395
Gassabys	360
White Hegari	280
Feterita	118
White Milo	107
Proso millet	40

Mixed Cropping Trials.

Mixed cropping plays a large part in native agriculture but no efforts are made to plant in alternate lines with any definite scheme of lay-out. The following trials were therefore conducted with a view to ascertaining the advantages or otherwise by mixed cropping as applied to better agricultural practice :—

Bonghanilo Sorghum Alternated with Cotton.
Tepary Beans Alternated with Kilinyali Sorghum.
Cotton Alternated with Groundnuts.
Cotton Alternated with Maize.

	Spacing	Yield per acre as single crop	Yield per acre as planted
		lbs.	lbs.
Bonghanilo	3′×18″ ...	718 ...	359
Cotton	3′×18″ ...	126 ...	63
Tepary beans	3′×18″ ...	Failure ...	—
Kilinyali	3′×18″ ...	1,133 ...	566
Cotton	3′×18″ ...	44 ...	22
Groundnuts	3′×18″ ...	637 ...	318
Cotton	3′×18″ ...	260 ...	130
Maize	3′×18″ ...	723 ...	361

ALTERNATE CROPS BUT TWO ROWS OF EACH.

Cotton and Groundnuts.

Groundnuts and Kilinyali Sorghum.

	Spacing	1 Yield per acre as single crop lbs.	2 Yield per acre as planted lbs.
Cotton	3″×18″	250	102
Groundnuts	3″×12″	976	478
Groundnuts	30″×12″	918	459
Kilinyali	30″×18″	624	312

The results tend to indicate that pure cropping is productive of greater yields per acre than mixed cropping. A computation of the yield as a pure crop (yield column 1) gives only fair yields as compared with results on previous pages (with the exception of Kilinyali sorghum where its adjacent crop was a complete failure) whilst the total yield of one acre under a mixed crop is definitely poor.

H. MARSLAND,
District Agricultural Officer.

ANNEXURE IX.

MIKINDANI AGRICULTURAL STATION.

1. The main rains were late in opening and short periods of drought were common in the early part of the growing season. The monthly rainfalls for 1930 and 1931 were as follows :—

Month	1930 mm.	1931 mm.
January	263·0	153·7
February	101·0	87·9
March	403·4	231·8
April	51·5	269·2
May	26·1	7·1
June	—	—
July	—	1·0
August	6·4	1·8
September	27·6	—
October	92·1	6·3
November	41·5	144·7
December	28·9	230·8
	1,041·5	1,134·3

2. All trials under report (excepting the rotation experiments) were carried out in ranges consisting of twenty contiguous rectangular plots of one-tenth acre each. As far as possible failures were supplied in all variety trials.

3. Statistical interpretation of results, where given, is in terms of the Standard Error of the mean difference. Where more than two varieties or spacings figure in a trial the Standard Error of the mean of *all* the differences is given. All calculations are based on the formulæ used by the Cambridge School (summarized in the "Principles and Practice of Yield Trials" (E.C.G.C., 1927).)

4. Trials were carried out on two types of soil, viz. :—

River Area: A sticky and very heavy black clay, subject to frequent flooding, and in times of drought, to drying out and cracking.

Middle Area and Upper Area: A clay loam, not subject to flooding or water logging. Can be worked during wet weather whereas the soil of River Area cannot be worked whilst wet.

Cotton Time of Planting Trial.

5. The trial was carried out on both types of soil mentioned above. In each section four plots were sown at intervals of a fortnight at a spacing of 3 feet by 1½ feet. All the plants were uprooted and burnt at the beginning

of October owing to a high incidence of pink boll worm. Although this seriously affects the yield figures given for the later plantings it was quite obvious that these would in any case have been negligible in comparison with the earlier cotton. The first four plantings were practically completely harvested before uprooting.

6. Heavy rains during March brought about a condition of water logging in River Area, with the result that the percentage stands for that month's plantings were very low. For the same reason no planting took place in River Area during April. The results are as follows :—

Table.

Date of planting	Rainfall mm.		River Area			Upper Area		
	Week previous to planting	Week following planting	Percentage stand	Yield Per acre lbs.	Yield Comparative	Percentage stand	Yield Per acre lbs.	Yield Comparative
January 2	45·0	Nil	76	600	100	72	540	100
,, 15	6·9	67·8	86	440	73	76	470	87
,, 31	60·4	12·7	69	340	57	72	440	82
February 14	27·3	19·6	69	190	32	76	280	52
,, 28	28·3	41·0	49	90	15	69	180	33
March 14	·5	101·5	10	10	2	73	70	13
,, 30	87·8	81·8	6	11	2	34	10	2
April 15	99·4	82·2	—	—	—	57(b)	Nil	—
May 1	6·8	7·1	59	30	5	45(b)	Nil	—
,, 15	Nil	Nil	—(a)	—	—	28(b)	Nil	—

(a) No planting, (b) Uprooted before harvest.

Comparison with 1930 Trial.

7. The corresponding figures for a similar trial carried out in 1930 are incorporated in the table below. Although the planting dates in both years do not exactly correspond they are reasonably accurate for comparative purposes :—

Table.

Date of planting	Yield per acre lbs.			Total rainfall in mm. of week before and week after planting	
	1930	1931 River area	1931 Upper area	1930	1931
January 2 ...	480	600	540	174·0	45·0
,, 15 ...	280	440	470	33·0	74·7
,, 31 ...	230	340	440	156·0	73·1
February 14 ...	170	190	280	29·5	46·9
,, 28 ...	120	90	180	117·7	69·3
March 14 ...	190	10	70	272·4	102·0
,, 30 ...	120	10	10	101·0	169·6
April 15 ...	80	—	—	22·0	181·6
May 1 ...	—	30	—	34·1	13·9

8. It is assumed for this table that during the two years in question, the optimum date of planting was at the opening of the rains and that, in general, successively later plantings were accompanied by decreased yields. As explained previously, the low yields for the 1931 crop planted after 14th February were due to uprooting before the conclusion of harvest. At least one of the factors contributing to the comparatively low yield per acre for the early plantings of 1930 is that the trial took place mainly in River Area and owing to water logging, germination was low and many seedlings succumbed. The result was a lower percentage stand than in 1931.

9. In both years of the trial, not only were the yields of the earlier plantings superior to those from later plantings but the early cotton was also superior in quality and less subject to destruction by pests, disease and vermin.

Sorghum Variety Trials.

10. These trials were carried out both in the River and Upper Areas, with four replicates of each variety in each of the two trials. The object was to compare the yields of the two common local varieties (Msukulu and Ludede) with three introduced varieties (Kilinyali, Sukesha and Bonganhilo). The spacings used in both trials were 3 feet by 1½ feet.

11. The following are the results of the two trials:—

River Area.—Trial laid down on 1st January.

Table.

Variety	Mean yield of 4 plots lbs.	Difference + 1·45	Difference ÷ S. E*
Msukulu ...	27·68	—	—
Ludede ...	20·50	7·18	4·9
Kilinyali ...	14·75	5·75	3·9
Sukesha ...	9·62	5·13	3·5
Bonganhilo ...	0·37	9·25	6·4

Assuming that a difference in yield between two varieties of three times its Standard Error is statistically significant, we may conclude from the table that the difference in yield between any two of the varieties in the trial is to be regarded with confidence as highly significant (i.e. Difference ÷ Standard Error exceeds the figure 3 in every case).

Upper Area.—Trial laid down on 2nd January.

Table.

Variety	Mean yield of 4 plots, lbs.	Difference + 5·39	Difference ÷ S. E*
Msukulu ...	42·00	—	—
Kilinyali ...	27·25	14·75	2·7
Ludede ...	25·12	2·13	0·4
Sukesha ...	14·18	10·94	2·0
Bonganhilo ...	6·25	7·93	1·4

*The Standard Error of the mean difference in yield between varieties was calculated to ±be145 lbs. per plot.

12. In this instance it is apparent that reliance cannot be placed in the differences between consecutive varieties but, by simple inspection and addition of the relevant figures in column 4 of the table, it may be said that Msukulu is superior to any of the last three varieties: that Kilinyali and Ludede are both superior to Bonganhilo: that Bonganhilo, although not inferior to Sukesha, is nevertheless inferior to the first three varieties, and so on.

13. Compared with 1930 the order of yield of these varieties was:—

Table.

	Pounds per plot, 1930		1931
Ludede	99	...	25
Msukulu	65	...	42
Kilinyali	47	...	27
Sukesha	45	...	14
Bonganhilo...	14	...	6

The inference is therefore that in both seasons the local varieties were superior to all three introduced varieties. Except that Ludede and Msukulu have altered their relative positions, the order of yield was the same in both 1930 and 1931.

14. It has become fairly obvious that the variety Bonganhilo is unsuited to the damp conditions prevalent on the coast. The heads become mouldy and insect infected in the field and the grain quickly deteriorates during storage. The only advantage so far observed in the introduced varieties over the two local varieties are that Bonganhilo is quicker maturing and that Sukesha and Kilinyali produce a cleaner and brighter grain. The latter advantage is probably due to the presence of smut in the local sorghums.

15. There was a high incidence of maize stalk borer in all varieties which was partly responsible for the decreased yields compared with 1930.

Rice Variety Trial.

16. In 1930, fourteen varieties were tested and of these the five most promising were selected for further trial. These varieties were:—

Sifara (local swamp variety);
Unyengwa (Rufiji hill variety);
Pakapaka (Morogoro hill variety);
Faya (Morogoro swamp variety);
Karafuu (Morogoro hill variety).

The trial was laid down on 3rd January, 1931, in the River Area, which is subject to periodical flooding. Each variety was repeated four times and the spacing adopted was one foot by one foot. The results are set out in the following table:—

Table.

Variety	Mean yield per plot lbs.	Difference +18·22	Difference ÷S.E.	Stand %	No. of days to maturity
Faya ...	283	... —	... —	... 85	... 142
Sifara ...	259	... 24	... 1·3	... 85	... 142
Unyengwa	142	... 117	... 6·4	... 72	... 115
Pakapaka	128	... 14	... 0·8	... 70	... 115
Karafuu	125	... 3	... 0·1	... 74	... 131

Comparison with 1930 :

Table.

Variety	Comparative yield, 1930		1931
Faya ...	V 69	...	I 100
Sifara ...	I 100	...	II 91
Unyengwa	III 76	...	III 50
Pakapaka	II 91	...	IV 45
Karafuu ...	IV 71	...	V 44

17. The 1930 yields cannot be taken as reliable as the trial consisted in some cases of only one plot of each variety and the growth conditions in the individual plots varied considerably.

18. As rice growing in this area is becoming of increasing importance it is necessary that an attempt be made to classify the indigenous varieties as has been done with the Rufiji rices. The type of trial carried out above, although of value, is too limited in its scope during the initial stages of the work and on this account small observation rows will be substituted as has been practised at Mpanganya Agricultural Station. It is proposed to incorporate in the scheme those introduced varieties already available on the station.

Maize Variety Trial.

19. The trial was laid down in the Upper Area on 6th January, 1931. The spacing adopted was 3 feet by 1½ feet the plants being thinned to one per hill at six inches high. There were four repetitions of each variety. The plants suffered from drought in the early stages, and later from a severe infestation of stalk borer.

Results:

Table.

Variety	Mean yield per, plot lbs.	Difference + 7·2	Difference ÷ S. E.	Percentage stand
Local flint ...	32·94	—	—	47
Potch. Pearl ...	25·63	7·31	1·1	38
Hickory King ...	18·94	6·69	0·9	28
Kenya Hybrid...	18·19	0·75	0·1	35
White Cango ...	10·75	7·44	1·0	14

The only significant difference is that between the local white flint and White Cango but from an inspection of the percentage stands it is evident that this is largely due to the discrepancy in the number of plants per unit area.

Comparison of Leguminous Food Crops.

20. Six varieties were sown in triplicate at a spacing of 3 feet by 1 foot. The first sowing was made on 9th January and although germination was good and the plants made excellent growth for about two weeks, an invasion of beetles (*Hallirhotius africanus*) wiped out the entire trial. Although three dustings of arsenic were given, the destruction was not checked to any appreciable extent.

21. The trial was completely resown on 24th April and again, owing to poor germination, on 6th May. The three introduced varieties, Tepary

beans, Canadian Wonder beans and Lima Abundance beans failed completely to germinate. The results with the three remaining varieties are shown in the following table :—

Table.

Variety	Mean yield per plot lbs.	Difference + 7·4	Difference ÷ S. E.	Percentage stand
Cowpea ...	64·00 ...	— ...	— ...	66
Bonavist bean...	56·17 ...	8·83 ...	1·2 ...	87
Green gram ...	34·08 ...	22·09 ...	2·9 ...	83

The Bonavist beans did not mature till nearly two weeks after the other two varieties.

Groundnuts Variety Trial.

2. The trial was sown on 12th February at a spacing of 2 feet by 1 foot. There were ten repetitions of each variety.

Results:

Variety.	Yield per plot. (lbs.)
Virginia Bunch	87·5
Local	69·7
Difference	17·8+2·9

23. It may be interesting to note that in spite of the lower yield of Virginia Bunch the cost of production was one shilling less per 100 lbs. than the local groundnuts. This was owing to the more spreading habit of the local variety which caused more difficulty in harvesting.

24. There was a slight incidence of rosette disease in the local variety but the disease was absent in Virginia Bunch. The latter matured at least one week before the local variety.

Simsim Spacing Trials.

25. Two sets of trials were carried out, one in the River Area and the other in the Upper Area. The spacings and yields of both trials are shown in the following tables :—

Table.

River Area.

Spacing	Mean yield per plot lbs.	Difference +3·9.	Difference ÷S.E.
Broadcast at 3 lbs. per acre ...	29·25 ...	— ...	—
1 foot by 1 foot with one plant per hill	27·63 ...	1·62 ...	0·50
1 foot by 1 foot with two plants per hill	27·38 ...	0·25 ...	0·07

Upper Area.

Spacing	Mean yield per plot lbs.	Difference + 5	Difference ÷S.E.
Broadcast at 3 lbs. per acre ...	8·38 ...	— ...	—
2′ × 1′ with two plants per hill...	7·71 ...	0·67 ...	0·13
3′ × 1½ with one plant „ „ ...	5·67 ...	2·04 ...	0·41

26. It is evident that no importance can be attached to the results, the standard errors in each case being too large.

27. The yields in the second trial were low owing to a severe attack of beetle grubs which killed the plants by boring in the stems.

Maize Time of Sowing Experiments.

28. Two maize time of sowing experiments were a failure owing to unsuitable soil conditions and low seed germination.

Rotation Experiment.

29. An experiment designed with a view to discovering the most suitable combinations of crops and the order in which they should be grown was commenced in January. These combinations are :—

A.	B.	C.	D.
Sorghum	Maize	*Simsim*	Maize
Maize	*Sorghum*	Maize	*Simsim*
Groundnuts	Groundnuts	Bonavist Beans	Bonavist Beans
E.	F.	G.	H.
Cotton	Sorghum	*Rice*	Sorghum
Sorghum	*Cotton*	Sorghum	*Rice*
Cowpeas	Cowpeas	Cowpeas	Cowpeas
	I.	J.	
	Maize	Rice	
	Rice	*Maize*	
	Bonavist Beans	Bonavist Beans	

30. Each rotation is repeated four times over a range of fifteen plots, three of these plots being planted continuously as a control with the main crop of the rotation (e.g. sorghum in rotations A and B). The plots are one-fortieth of an acre each, and are laid out in ranges of fifteen plots, each range bearing the reference letter of the particular rotation with which it is associated. It will thus be seen there are ten ranges each containing fifteen plots, making a total of 150 plots.

31. The yields have been written up and tabulated but are not given here as being of no interest at this stage. At the end of the third year of the experiment a useful discussion of the accumulated data should be possible.

Nursery Work.

32. Considerable difficulty was experienced in the nursery owing to seedlings dying off at various stages in their growth, possibly owing to alkalinity of the soil, or unsuitability of the well water used for irrigation. The effect of digging in a green manure crop will be tried during the 1932 season and if this does not improve the situation it will be necessary to remove the nursery to another site, which will, unfortunately, be a considerable distance from water.

33. Nursery work is for the present confined almost entirely to raising trees and shrubs for planting out on the station. As well as miscellaneous plantings of flowering shrubs such as Cassia, Hibiscus, Bougainvillea, etc. The following trees have been planted out from the nursery :—Forty citrus

trees, an avenue of flamboyante trees, and an avenue of toddy palms. Varying quantities of the following trees are available in the nursery for planting out during the 1932 season :—Saman ; Kapok ; Red Sandal Wood ; Cassia siamea ; Flamboyante.

Miscellaneous Crops.

34. Cuttings and suckers of cassava, sweet potato, banana and pineapple have been planted for the purpose of making observations on varietal differences of yield, period to maturity, etc. These were planted in July and irrigated. Except for the depredations of white ants these are making good progress.

35. *Soya Bean.*—A one-half acre plot was planted with soya bean (var. Brownie) in April. It was unable to withstand the drought and the pods ripened within a period of 84 days from sowing. The yield of seed was 17 lbs. A short maturing variety would probably show more promise.

36. *Calopogonium Mucunoides.*—About one pound of seed was sown broadcast on 5th February. The germination, owing to soil conditions, was poor so that the plants had little chance to cover the ground. Owing to water logging and subsequent drying out and cracking of the soil the plants died off in July. Six pounds seed harvested.

Seed Multiplication.

37. In addition to that from experimental areas, the following seed was harvested from multiplication plots :—

			lbs.	
Sorghum	...	var. Sukesha	721	
,,	...	,, Kilinyali	1,148	
,,	...	,, Bonganhilo	83	
Groundnuts	...	,, Virginia Bunch	539	(unhulled)
Maize	...	,, Hickory King	54	
,,	...	,, Kenya Hybrid	652	
Bonavist Beans	...	... ...	787	

R. D. Linton,
District Agricultural Officer.

ANNEXURE X.

EXPERIMENTS CONDUCTED AT MPANGANYA DURING THE 1931 SEASON.

1. *Indigenous Sorghums.*—Comparative trials on twenty-two varieties of indigenous sorghums were carried out and the figures recorded below in tabular form are of the average of four one-fortieth acre plots.

2. The low yield obtained is indicative that earlier planting is essential, in order that flowering may take place before the end of the rainy season.

3. It is to be remarked that the native shows preference for the varieties Ndogoro, Kibwe and Mbawara, the grain of these keeping well in store and being of good colour. Kibwe is considered to be the most promising variety for general purposes, but while there is no market demand for better types, the apathetic native will continue to grow all forms irrespective of their yields and keeping qualities. The variety Bonganhilo was almost entirely destroyed by smut.

Table.

Variety	No. of days to harvest	Comparative yield
Msimbiji	152	100
Jehere	152	97
Nokore	152	95
Kibwe	153	95
Mtambara	153	89
Kanga	152	86
Msigara	157	84
Ndungunya	157	84
Sungura	154	82
Kigumi	160	70
Libutuka	158	70
Mbangara	156	68
Mbawara	154	63
Nganena	147	63
Karaza	153	54
Ndogoro	168	52
Msiganga	158	52
Topeka	160	45
Mgana	160	45
Sukesha	158	36
Kilinyali	—	—
Bonganhilo	—	—

4. *Cotton Variety Trials.*—The plots were planted on the 14th April and early harvesting began on the Mp. selections on 10th August and a fortnight later on the other varieties. Harvesting continued until early December.

5. During the early part of August, field rats and mice were very destructive and elephant and eland also did considerable damage to the crop. In these circumstances the figures for yield have no significance.

6. The varieties U 4 4 10, U 4 4 2, H 67, H 68, R M 53 and R M 56 grew well and would possibly have done better and a wider spacing been adopted. The number of bolls per plant was much greater than from native cotton. None of the Mp. selections are outstanding and it is recommended that experiments with Mp.s 1 should not be continued as no two plants in the plot were identical. In three cases very poor germination made any comparisons futile.

7. All plants kept green and healthy until they were uprooted and none of the varieties gave any indication of drought resistant qualities.

8. Angular leaf spot was the only disease to attack the plants, but this was not sufficiently serious to affect the yields. The results of the experiments are given in the attached table.

Variety	Seed lint weight grammes	100 seeds seed grammes	Lint index	Ginning	Length of lint Max	Length of lint Min.	Length of lint Av.	Bolls wth 5 loculii	Seeds per boll	Yield 1/40 acre	Height	Foliage size hirsuitness	Bolls L × B	Branches close distant	Angular leaf spot disease
				%				%		kgs.	feet.		ins.		%
C. 15 ...	15.90	10.60	5.30	33	$1^3/_{16}$	1	$1^2/_{16}$	45	38	11	7	Medium Slightly	$2\frac{1}{2} \times 1\frac{1}{4}$	Medium	Nil
Native ...	14.95	11.05	3.90	27	$1^3/_{16}$	$^{14}/_{16}$	1	20	32	13	6	,,	$2\frac{1}{2} \times 2$ varied	Open	25
H. 77 ...	15.45	10.85	4.60	30	$1^5/_{16}$	$1^1/_{16}$	$1^3/_{16}$	10	37	12	6	Small Slightly	$2 \times 1\frac{1}{2}$	,, numerous	35
R.M. 53...	12.90	9.15	3.75	29	$1^1/_{16}$	$^{15}/_{16}$	1	10	33	$13\frac{1}{2}$	6	,,	$2\frac{3}{4} \times 1\frac{3}{4}$ large	Close	40
Z. 9 ...	14.05	9.10	4.95	35	$1^1/_{16}$	1	1	60	38	14	5	Large Very	$2 \times 2\frac{1}{2}$ large	Moderate short	3
R.M. 68...	17.05	11.40	5.65	34	$1^4/_{16}$	$1^1/_{16}$	$1^2/_{16}$	Nil	36	8	5	Moderate Very	$2\frac{1}{2} \times 2$ large	Close	Nil
H. 67 ...	15.90	10.70	5.20	33	$1^2/_{16}$	1	$1^1/_{16}$	Nil	39	15	6	Small Slightly	$2 \times 1\frac{1}{2}$	,,	32
Z. 14 ...	15.60	10.40	5.20	33	$1^4/_{16}$	$1^3/_{16}$	$1^3/_{16}$	Nil	34	$8\frac{1}{2}$	6	,,	$2 \times 1\frac{1}{2}$	,,	40
U/4/4/10	16.60	10.55	6.05	36	$1^4/_{16}$	$1^1/_{16}$	$1^3/_{16}$	18	33	20	6	,,	$2 \times 1\frac{1}{2}$ rounded	,,	2
Uganda	13.50	8.70	4.70	34	$1^2/_{16}$	$^{15}/_{16}$	$1^1/_{16}$	Nil	36	$10\frac{1}{2}$	7	Moderate Slightly	$2 \times 1\frac{1}{2}$	Open	10
U/4/4/2...	13.90	8.75	4.15	30	$1^4/_{16}$	1	$1^2/_{16}$	10	31	26	$5\frac{1}{2}$	Small Very	$1\frac{1}{2} \times 1\frac{1}{2}$	Classe	5
Mp. 9/3	12.90	8.80	4.10	32	$1^3/_{16}$	$^{15}/_{16}$	$1^1/_{16}$	20	38	—	6	Moderate Slightly	$2 \times 1\frac{1}{2}$	Open	50 also stainer
Mp. 9/2	14.50	9.30	5.20	35	$^{15}/_{16}$	$^{12}/_{16}$	$^{14}/_{16}$	10	34	$21\frac{1}{2}$	5	Moderate Very	$2 \times 1\frac{1}{2}$ pointed	,,	42
Mp. 19...	14.45	10.10	4.35	30	$1^2/_{16}$	$^{11}/_{16}$	$1^1/_{16}$	13	34	16	3	Small Very	$2 \times 1\frac{1}{2}$	Moderately close	30
Mp. 13/3	13.60	10.20	3.40	37	$1^3/_{16}$	1	$1^1/_{16}$	18	32	—	3	Small Slightly	$2\frac{1}{2} \times 1\frac{1}{2}$	,,	Nil
Mp. 8/1 ...	10.70	8.77	1.93?	18?	$^{15}/_{16}$	$^{9}/_{16}$	$^{12}/_{16}$	3	30	$11\frac{1}{2}$	5	Moderate Slightly	$2\frac{3}{4} \times 1\frac{1}{2}$ varied	Varied	45
Mp. 12 ...	11.80	8.53	3.38	29	$1^3/_{16}$	$^{14}/_{16}$	1	Nil	32	—	$4\frac{1}{2}$	Moderate Very	$2 \times 1\frac{1}{2}$	Open	Nil
Mp. 4/2...	14.70	10.47	4.23	29	$1^1/_{16}$	$^{14}/_{16}$	$^{15}/_{16}$	Nil	34	—	5	Moderate	$2\frac{1}{2} \times 1\frac{1}{2}$	,,	Nil

9. *Groundnuts: Spacing Experiment.*—The result of this experiment goes to show that the wider spacing is to be preferred. This allows for after-cultivation to be done more easily and thoroughly, as with a careless and indifferent cultivator damage to the plants and roots is inevitable. The narrower spacing does not allow of sufficient space in which to use a native hoe.

Table.

Ground Spacing Experiment

Spacing	Comparative yield
12 inches by 6 inches	90
12 ,, by 9 ,, ...	95
18 ,, by 3 ,, ...	80
18 ,, by 6 ,, ...	100
18 ,, by 9 ,, ...	95

10. *Cover-Crops.*—The plots of cover and green manure crops were sown in April and they received no cultivation or further attention whatever. The comparative values as cover are shown below. For permanent cover, *Passiflora fœtida* is the most satisfactory with pigeon pea, *Cajanus indicus* and *Crotalaria* sp. next in order. The Bonavist bean, *Dolichos Lablab*, and the Bengal bean proved to be excellent temporary cover-crops but at the height of the dry season when they are most required they die off :—

Table.

Kind	Cover in September	Cover in December
Calopogonium mucunoides	80 ...	80
Sword bean *Canavalia ensiformis* ...	100 ...	5
Pigeon pea *Cajanus indicus*	80 ...	90
Crotalaria sp.	80 ...	80
Dolichos Hosei	80 ...	nil
Bonavist bean *Dolichos Lablab*	100 ...	10
Bengal bean	100 ...	5
Bengal bean (white)	100 ...	5
Sweet potato *Ipomoea Batatas*	95 ...	45
Passiflora fœtida	90 ...	100
Lima beans *Phaseolus lunatus* ...	50 ...	nil
Cowpea *Vigna Catiang*	50 ...	nil

11. Spacing trials of sesame and pigeon pea and variety trials of bulrush millets were abandoned through vermin destroying the seed.

H. Musk,
District Agricultural Officer.

APPENDIX I.

List of European Staff as on 31st December, 1931.

Director: E. Harrison, Head Office, Morogoro.
Entomologist: A. H. Ritchie, Moshi.
Assistant Entomologist: W. V. Harris, Laboratory, Morogoro.
Mycologist: G. B. Wallace, Laboratory, Morogoro.
Senior Agricultural Officers: C. K. Latham, Lindi; A. S. Richardson, Mwanza; A. J. Wakefield, Moshi.

Agricultural Lecturer: A. E. Haarer, Bukoba.

District Agricultural Officers: L. C. Edwards, Biharamulo; D. G. Burns, Mwanza; C. M. H. Sutherland, Dodoma; C. B. Garnett, on leave; D. Sturdy, Arusha; H. Musk, Mpanganya; A. S. Stenhouse, Songea; C. Harvey, Moshi; C. J. McGregor, Iringa; A. H. Savile, Maswa; N. V. Rounce, on leave; J. E. Bruce, Handeni; B. J. Hartley, Mwanza; W. B. Hutchinson, Nzega; R. D. Linton, Lindi; J. Robertson, on leave; F. R. Sanders, Moshi; H. Marsland, Shinyanga; T. C. Cairns, on leave; F. W. Thomas, Lushoto; N. R. Fuggles, Morogoro District; J. R. Curry, Singida; G. W. Lock, Tanga; R. M. Davies, Tukuyu; R. B. Allnutt, Masasi; D. Thornton, Musoma.

Head Gardener: T. H. Marshall, Experiment Station and Head Office, Morogoro.

Agricultural Assistants: E. T. Ward, Experiment Station, Morogoro; R. W. Collett, Dar es Salaam; T. S. Jervis, on leave; L. Leslie-Moore, Bukoba; G. S. Brown, Ibadakuli, Shinyanga; B. E. Eustace, Tukuyu; W. C. Clarke, Mwanza; A. Taylor, Moshi; J. S. Scott, Ngudu; W. S. Warne, Mpapura, Mikindani; G. H. Pattison, Kasulu; C. J. M. Krige, Iringa.

Chief Clerk: W. E. Pownall, Head Office, Morogoro.

Clerks: C. H. Taylor, Head Office, Morogoro; D. F. T. Brown, on leave.

APPENDIX II.

(a)—Distribution of Planting Material during the Year ending 31st December, 1931.

Cotton seed	1,050 tons.
Groundnuts	26,119 lbs.
Maize	22,264 ,,
Millets and Sorghums	4,055 ,,
Beans and Peas	14,957 ,,
Rice	1,681 ,,
Potatoes	13,800 ,,
Coffee	16,664 ,,
Cassava	5 tons and 5,450 cuttings.
Tea	3,010 lbs.
Eleusine	198 ,,
Simsim	10,800 ,,
Tobacco	6 ,,
Buckwheat	64 ,,
Saltbush	198 ,,
Bananas	66 suckers.
Edible Canna	90 lbs. rhizomes.
Pineapple	200 suckers.
Spineless cactus	2 bags cuttings.
Khus-khus grass	2 bags rhizomes.
Cover crops, green manure and shade trees	150 lbs.
Miscellaneous seeds	348 packets.
Citrus	807 plants.
Fruit	88 ,,
Decorative plants	3,065 ,,
	27 bundles of cuttings.
	4 bags rhizomes.

(b)—Plant Introductions 1st April to 31st December, 1931.

COTTON SEED:

U/4 Bulk.
Selections from Strain U/4.
U/4/64/4.
U/4/26/4.
U/4/64/7.

COVER CROPS:

Centrosema Plumieri.
Clitoria cajanifolia.
Tephrosia candida.
Crotalaria agathiflora.
,, *incana.*
,, *usaramaensis.*
,, *anagyroides.*
Lathyrus sativa (wedge pea).
Yellow lupin.
Lotus major.

FODDER PLANTS:

Atriplex angulata (Dwarf saltbush).
Pennisetum Ruppeltii.
Eucalyptus albens.
Eragrostis abyssinica (Teff grass).
Andropogon Sorghum (var. Sudan grass).
Canna edulis (Queensland arrowroot).

FOOD PLANTS:

Madagascar butter beans.
Canadian Wonder beans.
Pigeon Pea (improved strains).
Bombay Onion seed.
Potatoes (Kerr's Pink).
Groundnuts (selected strains from Mauritius and Madagascar,
Bombay wheat.
Maize var. Chester County.
,, ,, Natal 8 row.
,, ,, Wisconsin White Dent.
,, ,, Yellow Horsetooth.
,, ,, Hickory King.
,, ,, Salisbury White.
,, ,, Natal Yellow.
,, ,, Ladysmith Pearl.
,, ,, Potchefstroom Pearl.
,, ,, Horsetooth (Yellow).
,, ,, ,, (White).

OIL SEEDS:

Niger oil: *Guizotia abyssinica.*
Tung oil: *Aleurites Fordii.*
Peppermint: *Mentha piperita.*
Lavender: *Lavendula vera.*
Rosemary: *Rosmarinus pyramidalis.*
Cajeput: *Melaleuca leucadendron.*
Patchouli oil: *Pelargonium radula-roseum.*
Origanum microphyllum.
Geranium oil: *Pogostemom Patchouli.*

TOBACCO, VIRGINIA:

Groot Swazi.
Imperial Clarkesville.
Turkish, 19 strains.

VARIOUS:

Cedrela Toona (Toon tree).
Abroma augusta (Devils cotton).
Canarium commune (Java almond).
Catha edulis.
Curcuma longa.
Dovyalis caffra (Kei apple).
Flacourtia cataphracta.
Lucuma nervosa.
Piper nigrum (pepper).
Olea europea (olive).
Acacia decurrens.
Rhamnus Purshiana (Cascara Sagrada).
Cinchona sp. (Quinine).
Chrysanthemum cinevariæfolium (Pyrethrum seed).
Elettaria cardamomum (Cardamom).
Hibiscus Sabdariffa var. *altissima* (roselle).
Acocanthera longiflora.
Bauhinia purpurea.
Calpurnea aurea.
Cassia grandiflora.
Cotoneaster pannosa.
Gleditschia triacanthos.
Lagunaria Patersonii.
Milletia oblata.
Vitex keniensis.
Derris elliptica.

APPENDIX III.

List of Ginneries Existing in 1931.

Province and District	Locality	Number of Gins		Licencee
		Saw	Roller	
Eastern :				
Dar es Salaam ...	Ruvu	—	26	India-Uganda Cotton Mer., Ltd.
,, ...	Dar es Salaam ...	1	16	Liverpool-Uganda Co., Ltd.
,, ...	‡Pugu	1	11	Abdulrasul and Sons
Morogoro... ...	Morogoro ...	—	28	Tanganyika Cotton Co., Ltd.
,, ...	Mikese	3	19	Japan Cotton Trading Co.
,, ...	Ngerengere ...	1	7	Liverpool-Uganda Co.
,, ...	‡Mlali	—	18	Tanganyika Cotton Co.
,, ...	Duthumi ...	1	8	,, ,,
,, ...	‡Mkata	—	12	,, ,,
,, ...	Turiani ...	—	6	,, ,,
Kilosa	Kilosa	—	14	E.A. Planters Association, Ltd.
,, ...	†Kimamba ...	—	—	N. H. Georgiades
,, ...	Rudewa	—	21	Tanganyika Cotton Co.
,, ...	Msowero ...	—	6	Kladitis and Samaris
Bagamoyo ...	Bagamoyo ...	1	8	Holy Ghost Mission
,, ...	‡Kisauke* ...	—	2	S. G. Drosopoulos
Rufiji	Kilimani ...	—	12	Kilimani Estates
,, ...	‡Logeloge ...	—	6	Logeloge ,,
Lindi :				
Lindi	Lindi	—	10	Mathuradas Kalidas
,, ...	Mtua	—	8	,, ,,
Kilwa	‡Kikanda	1	8	Jaffer Samji & Co.
Tanga :				
Tanga	‡Tongoni	1	10	G. Galanos
Pangani	‡Langoni	—	—	Kwashemshi Estates
Handeni	‡Mamundu ...	1	—	,, ,,
,, ...	Mzundu	1	—	,, ,,
,, ...	Kwangero ...	1	—	,, ,,
Northern :				
Moshi	‡Moshi	—	6	N. Dadani
,, ...	Himo	1	12	Moshi Trading Co.
,, ...	‡Himo*	—	2	A. Mongardi
,, ...	‡Himo*	1	1	F. Deusebis
Mbulu	‡Idulu	—	5	M. Michaelakis
Tabora :				
Shinyanga ...	‡Usogore	4	—	B. E. A. Corporation, Ltd.
,, ...	‡Luhombo ...	4	—	,, ,, ,,
Mwanza :				
Mwanza	Mwanza	—	20	Nakasero Trading Co., Ltd.
,, ...	Murutunguru ...	1	10	White Fathers Mission
,, ...	Ihale	—	14	Mwanza Cotton Trading Co.
,, ...	Bukumbi ...	—	12	Bhagwanji Sunderji & Co.
Kwimba	Nyambiti ...	2	6	British Cotton Growing Association
Maswa	Nyanguge ...	2	8	,, ,, ,, ,,
,, ...	Pambani ...	—	11	Kampala General Agency
,, ...	Runere	5	—	B. E. A. Corporation, Ltd.
,, ...	Malampaka ...	5	—	,, ,, ,,
,, ...	Nasa	—	12	Marandas Rajaram & Co.
Bukoba :				
Biharamulo ...	‡Biharamulo ...	2	—	British Cotton Growing Association

*Private ginneries. †Non-native cotton only. ‡Not licensed in 1931.

Appendix IV.

Tanganyika Territory.—Principal Exports, 1913 and 1927-28-29-30-31.

Export	1913		1927		1928	
	Quantity Cwts.	Value £	Quantity Cwts.	Value £	Quantity Cwts.	Value £
Sisal	416,680	535,580	660,240	1,160,735	723,720	1,111,429
Hides and Skins	69,120	274,511	55,802	238,890	65,848	374,830
Cotton	43,840	120,753	78,814	361,916	97,863	495,405
Copra	109,540	117,401	145,340	143,024	186,360	191,197
Groundnuts	179,220	95,932	282,940	238,082	211,900	188,582
Beeswax	11,180	70,743	11,169	80,863	9,815	71,079
Coffee (raw)	21,180	46,563	131,899	463,420	208,622	739,657
Simsim	29,520	20,407	74,660	74,017	64,300	61,342
Rice	15,420	8,717	78,820	72,253	79,973	85,884
Millet	18,210	5,498	72,268	29,164	154,636	52,243
Total	913,910	1,296,105	1,591,952	2,862,364	1,803,037	3,371,648

Export	1929		1930		1931	
	Quantity Cwts.	Value £	Quantity Cwts.	Value £	Quantity Cwts.	Value £
Sisal	914,560	1,485,593	999,240	1,172,315	1,118,780	707,177
Hides and Skins	50,988	223,002	41,872	123,471	42,220	83,915
Cotton	98,948	487,863	73,414	247,413	48,526	119,752
Copra	158,400	145,015	147,900	109,733	144,680	62,209
Groundnuts	155,300	120,448	346,660	186,567	61,400	28,706
Beeswax	6,721	48,149	3,773	20,297	12,143	47,010
Coffee (raw)	177,140	588,871	230,940	397,040	185,020	247,037
Simsim	85,120	74,773	62,300	32,547	76,560	36,715
Rice	51,884	58,985	90,131	73,682	95,095	51,209
Millet	95,323	30,334	36,288	8,234	105,407	20,710
Total	1,794,384	3,263,033	2,032,518	2,371,299	1,889,831	1,404,440

APPENDIX V.

Summary of Expenditure for the period April 1st to December 31st, 1931.

	Provision for the period 1/4/31 to 31/3/32	Expenditure for the period 1/4/31 to 31/12/31
PERSONAL EMOLUMENTS.	£	£
Administrative (including total cost of Headquarter's staff)	4,607	3,084
Scientific Staff	2,972	2,220
Field Staff	32,651	21,766
Total Personal Emoluments ...	40,230	27,070
OTHER CHARGES.		
Travelling (including Railway Fares and Freight, Travelling and Transport Allowances and Passages)	10,430	4,536
Upkeep of Experimental Stations and Plantations ...	3,935	2,185
Purchase of Seeds and Upkeep of Ploughing Schools ...	500	198
Plant Sanitation and Purchase of Scientific Equipment ...	420	176
General expenditure	1,938	737
Contributions :—		
(a) Scholarship Scheme	1,330	1,330
(b) Imperial Agricultural Bureaux...	200	200
(c) ,, Bureau of Entomology	500	500
(d) ,, ,, ,, Mycology	100	250
(e) East African Agricultural Research Station ...	6,000	6,000
(f) Colonial Agricultural Service—Central Fund ...	540	540
Total Other Charges ...	25,893	16,652
SPECIAL EXPENDITURE.		
Office Safe	50	42
Anti-Locust Measures...	4,000	2,106
Expenditure from Cotton Cess	9,860	1,531
Total Special Expenditure ...	13,910	3,679